TURCK

Industrial
Automation

IMB SYSTEM USER MANUAL

HONEYWELL

Sense it! Connect it! Bus it! Solve it!

Edition 04.11
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TURCK
IMB
Pwr
IMB-AO-22Ex-Hi
24VDC
IMB-BP-8-H-OR
Backplane

1 Safety notes

WARNING

Observe the instructions in this manual
This section should be read without fail since safety in the handling of electrical equipment should not be left to chance.

1.1 About this manual

This manual contains the information required for the correct use of the IMB products for Honeywell. It was specially written for suitably qualified personnel.

1.2 Intended use

To ensure correct and safe operation of the devices, proper transportation, storage, assembly and installation, as well as careful operation and maintenance must be ensured.

1.3 Compliance with the standards

The operator is responsible for the proper compliance with currently applicable standards with regard to installation, operation and maintenance.

1.4 Product engineering/installation instructions

WARNING

Risk of personal injury and damage to property
Observe the instructions in this manual
The devices described in this manual must only be used for the intended applications described herein and in the relevant technical description, and only in conjunction with certified systems and components of other suppliers. The safety and accident prevention regulations for the relevant application must be observed without fail.

1.5 Explanation of symbols used

The following symbols are used in these instructions:

DANGER

Certain risk of personal injury
Proceed with special caution.
This symbol is shown next to warnings, indicating a potential source of danger.
This refers to personal injury or death that are almost certain if warning instructions are not observed.

WARNING

Possible risk of personal injury
Proceed with special caution.
This symbol is shown next to warnings, indicating a potential source of danger.
This refers to personal injury or death which may occur if the warning instructions are not observed.

CAUTION

Risk of damage to devices
Proceed with special care.
This symbol is shown next to warnings, indicating a potential source of danger.
This refers to possible damage to systems (hardware and software) and installations.

NOTE

Important information and description of a particular procedure
This symbol is placed next to general instructions that indicate important information on the procedure for one or several operations. The relevant instructions may simplify the work and help for example to avoid additional work caused by incorrect actions.

TECHNICAL INFORMATION

Description of technical principles and operating methods of the devices
This symbol is shown next to technical information, technical principles and background information.
This information provides a better understanding of the operation of the device.
The regular user can skip this type of information.

➤ REQUESTED ACTION

This symbol indicates actions to be carried out by the user.

REACTION SYMBOL

This symbol indicates results and reactions to particular actions.

1.6 Instructions prior to installation work

WARNING

Electrical voltage
Please observe the following safety precautions prior to installation work:

- Please follow the respective instructions for mounting the device.
- All work relating to transport, installation, commissioning and maintenance must only be carried out by suitably qualified personnel (EN 60079-17:2008 chapter 4.2.).
- When carrying out installation work ensure that you are free of electrostatic charge before touching the device.
- Connection and signal cables must be installed so that inductive and capacitive interference do not adversely affect the automation functions.
- Automation engineering equipment and its service components must be installed so that they are protected from accidental operation.
- In order to prevent a cable or wire breakage on the signal side from causing undefined states in the automation equipment, relevant safety measures must be implemented for the I/O interface on the hardware and software side.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units that comply with the requirements of IEC 60 364-4-41 or HD 384.4.41 S2 (VDE 0100 Part 410).
- Variations or deviations of the supply voltage from the nominal value must not exceed the tolerance limits specified in the technical data, otherwise this may cause malfunctions and dangerous conditions.
- Emergency stop devices in accordance with IEC/EN 60 204-1 must remain effective in all operational states of the automation equipment.
- The unlatching of emergency stop devices must not initiate a restart operation.
- Built-in devices for housings or cabinets must only be operated or serviced after they have been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Precautions must be implemented so that a program may be correctly restarted after it has been interrupted by voltage drops and power failures. This should not cause dangerous operating states even for a short time.
  It must be possible to force an emergency stop if necessary.
- At locations where failures of the automation equipment may cause injury to persons or damage to property, external measures must be taken that ensure or force a safe operational state in case of fault or malfunction (for example, with the help of independent limit switches, mechanical interlocks, etc.).
- The electrical installation must be carried out in accordance with the relevant regulations (for example, cable diameters, fuse protection, grounding equipment conductor).

2 Description of the interface system IMB

The TURCK IMB series (Interface Module Backplane) is a system consisting of interface modules and a control system specific backplane. The system is designed to enable the connection of field devices in installations with explosion hazardous areas to control systems without Ex i terminals.

Through the universal design of the backplanes, it is only necessary with this system to select the backplane according to the specific control system and the required connector type, but not according to the functions provided. With this type of point-to-point connection via the IMB series, the intrinsically safe signals are connected through individual cables in the Ex jumpering level to the light blue terminals.

The connection to the control system is implemented with pre-assembled system cables (see Figure 1, A). In this way, the risk of wiring faults is kept to a minimum.

TECHNICAL INFORMATION

Point-to-point connection

The point-to-point connection is one of the most tried and tested methods used in automation technology. Point-to-point connections are connections in which precisely two communication partners are involved. This enables a service to be executed with the simplest resources.
Any damage to the cable does not unavoidably lead to the failure of the entire information content. Through the use of state-of-the-art communication methods the remote operation of transmitters or sophisticated diagnostics are also possible.

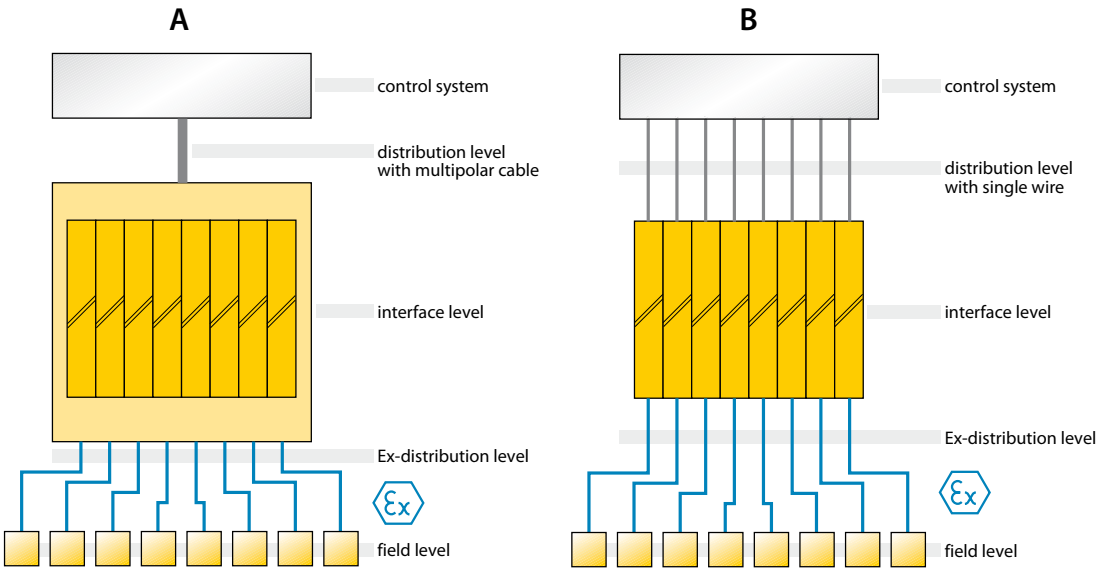


Figure: 1
Point-to-point connection with:
A: System cable
B: Single wire

The IMB system, as part of TURCK's product series of interface devices, is a user-friendly way of using system cables to quickly connect signals from the Ex area to the control system. Particular importance was placed here on reducing the space required.

The unique temperature management function eliminates any restrictions with regard to the mounting direction.

A high level of failsafe performance is ensured thanks to the possibility of implementing a redundant power supply. (see chap. 2.7).

2.1 Other interface solutions TURCK

Product series	Interfacemodul IM	Interfacemodul cartridge IMC	Interfacemodul Efficiency IME	Interfacemodul Small IMS
Features	Signal adaption, intrinsically safe inputs and outputs, galvanic isolation, DIN rail mounting	Signal adaption, intrinsically safe inputs and outputs, galvanic isolation, DIN rail mounting, cabinet-free installation in Zone 2, IP67	Signal adaption, intrinsically safe inputs and outputs, galvanic isolation, DIN rail mounting	Signal adaption, galvanic isolation, DIN rail mounting, housing width only 6,2 mm

Table: 1
TURCK product series for interface devices

2.2 Type code

The type code of the IMB series consists of a number and letter combination:

1st place Product family designation	
IMB	Interface Module Backplane
2nd place Function	
DI	Digital Input: digital NAMUR input, isolating switching amplifier
DO	Digital Output: digital output, intrinsically safe power supply, valve control module
AI	Analog Input, analog passive input 0…20 mA, analog input amplifier
AiA	Analog Input Active: analog active input 4…20 mA, isolating transducer
AO	Analog Output: analog output amplifier 4…20 mA
Ti-RTD	Temperature Input: resistance temperature detection, temperature measuring amplifier for resistance sensors, Pt100 amplifier
Ti-TC	Temperature Input: thermocouple, temperature measuring amplifiers for thermocouples, thermocouple amplifiers
3rd place Number of channels inputs/outputs and alarm outputs	
22	Two inputs, two outputs
231	Two inputs, three outputs, of which one alarm output
44	Four inputs, four outputs
451	Four inputs, five outputs, of which one alarm output
4th Place Designation for explosion-proof equipment	
Ex	Associated equipment with intrinsically safe field circuits
-	No Ex protection (“Ex” omitted)
5th place Output current circuit	
P	PNP or positive switching, normally open
N	NPN or negative switching, normally closed
H	For HART® signal transparent device
i	Current output
C	Can be set via the PC
6th place Power supply	
24VDC	24 VDC power supply

Example:

IMB-DI-451Ex-P/24VDC

Isolating switching amplifier, four inputs, five outputs, of which one alarm output, associated equipment with intrinsically safe field circuits, PNP switching, normally open, 24 VDC power supply

2.3 Note on explosion protection

DANGER

Risk of explosion! The nonobservance of Ex protection requirements may cause direct personal injury.
Observe the requirements for Ex protection.
Refer to chapter 5.3.2, page 32 for the relevant Ex data for the IMB system.

The interface modules comply with ignition protection type "intrinsic safety" in accordance with IEC 60079-11.
This enables the connection of intrinsically safe circuits from gas zones 0, 1 and 2 as well as dust zones 20, 21, and 22.

Intrinsically safe circuits are circuits with a limited current; these can be routed to zone 0 (for gas explosion protection) and 20 (for dust explosion protection).
The benefit of intrinsic safety is the fact that maintenance is possible during operation and in the presence of an explosive atmosphere. This also includes the interruption and possible short-circuiting of electrical circuits. A "hot work permit" is not required.

2.4 Verification of intrinsic safety

If intrinsically safe equipment is to be connected with associated equipment, the observance of explosion protection must be examined in accordance with the installation requirements of EN 60079-14 [1].

The examination must completed in two stages:

- Check whether the safety parameters of the active device (marked with the subscript "O" for Output) are less than the safety parameters of the passive device (marked with the subscript "I" for Input).
- Check to ensure that the sum of all connected inductive loads and capacitances does not exceed the permissible values of the associated equipment. It must be ensured here that the values of the cable are added to the values of the field device. The 50 % rule should be applied if concentrated reactances are present.

The values must be taken from the EC type examination certificates. If the cable values cannot be determined, section 12.2.2 of EN 60079-14 states that an inductive load of 1 µH/m and a capacitance of 200 pF/m can be assumed.

The devices must not be connected until both conditions have been fulfilled. See also calculation example: See chapter 5.3.3, page 33.

2.5 Galvanic isolation

Galvanic isolation ensures safe signal transmission. Modern circuit concepts are used for this purpose, ensuring both the required speed as well as a high degree of transmission accuracy. Galvanic isolation is mandatory for connecting sensors in Zone 0.
The input circuits are isolated from the output circuits and from the power supply.
The analog input and output modules are isolated from each other channel-by-channel on the field side.

2.6 Passive backplane

The backplane is primarily an electromechanical component.
Maximum reliability is achieved by the omission of any active electronics.
The backplane holds the interface modules and connects the input and output terminals with the interface modules.

2.7 Redundant power supply

The system can be fed from two independent power supply units in order to increase operational reliability.
Two removable terminal blocks are provided for connection (see Figure 2).
The connectors are designed so that the cables are led out at the top, thus ensuring that the backplanes can be fitted directly next to each other.
The disconnection or switching of the power supply is implemented by means of an electronic circuit on the interface modules.
Each interface module is provided with an LED that indicates the presence of the power supply.
The backplane has no functional electronics as the disconnection/switching between the power supply units is carried out on the interface modules.

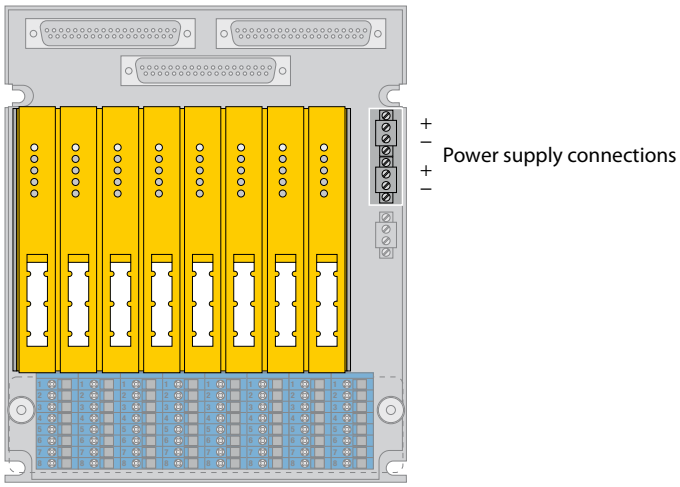


Figure: 2

Redundant power supply connection

2.8 Connection of the control system

Three slots are provided for the connection of the Honeywell control system for digital and analog signals of the system cables (see Figure 3). The upper two slots are used for the digital signals and the lower slot is used for the analog signal.

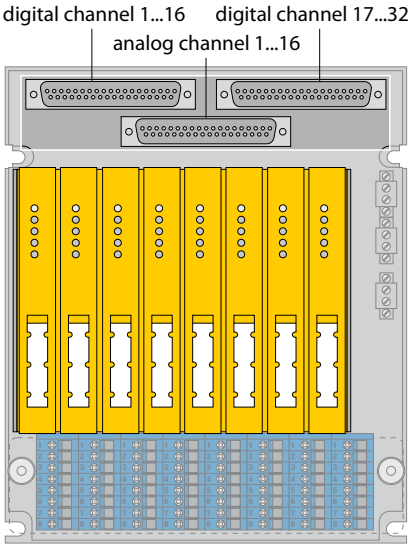


Figure: 3
Connection of the control system

2.9 HART® interface

A HART® multiplexer can be connected for parameterizing intelligent HART® field devices. If a HART® multiplexer is to be fitted as well, a cable to the control system must be plugged into the HART® multiplex connector in parallel, e.g. via a Y connector.

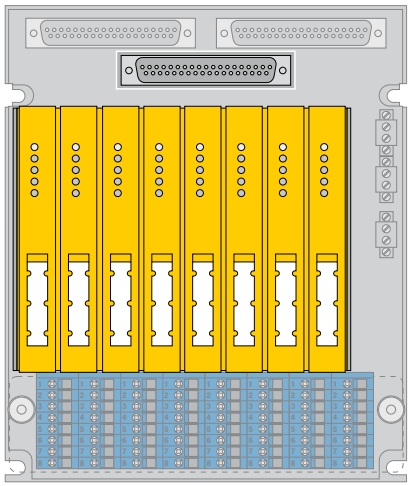


Figure: 4

Connecting the HART® multiplexer

3 Operating conditions

3.1 Ambient temperature

The IMB system is suitable for operation at ambient temperatures between -25…+70 °C.
The system is designed to ensure a proper heat flow in any installation position. Openings on four sides that provide protection to IP20 allow the heat to flow unhindered. The boards are also provided with openings at strategic locations.
These measures enable the system to be operated in any mounting position over the entire temperature range.

3.2 Humidity protection

The boards of the IMB system are coated with a protective lacquer. As well protection against sparkovers, the lacquer also acts as a humidity barrier. Short term condensation of the system during operation is therefore possible.

3.3 IP protection

The IMB system is specified as associated equipment for installation in the safe area.
The IEC 60079-11 standard stipulates that these types of devices must be provided with protection to IP20. As it is a modular system, the user must therefore comply with these requirements. The IP20 protection requirement is fulfilled when fully fitted, for which dummy modules must be used on empty slots.

WARNING

Risk of explosion! Risk of personal injury through the penetration of metal foreign bodies
Observe degree of protection IP20.
If individual modules are not to be fitted, the empty slots must be filled with a dummy module (IMB-BM).

NOTE

Activation of an alarm due to empty slots not being filled with IMB-BM dummy module
The alarm is activated if the empty slots are not filled with the IMB-BM dummy module.

3.4 Installation in mounting cabinet

The IMB system is designed for optimum space utilization. The large number of channels of the interface modules as well as the compact backplane provide the optimum basis for the economical use of the mounting cabinet space. The dimensions were selected so that an optimum packing density can be achieved.

The IMB system can also be mounted vertically or horizontally with screws, irrespective of the alignment of the DIN rail. Only the position of the rear mounting adapter that is fastened with four screws has to be fastened accordingly (see chapter 4.1, page 20).

CAUTION

Possible device damage due to heat pockets

Ensure when mounting in the mounting cabinet that the formation of heat pockets is prevented. This can be achieved by fitting fans in the roof of the mounting cabinet. Effective cable routing and ducting should be implemented to ensure that the heat flow is unimpeded.

3.5 Installation in vibrating environments

NOTE

Use in vibrating environments

End blocks should be mounted at the ends. If the system is to be used in a vibrating environment, we recommend the use of a locking screw.
The locking screw is already provided with the factory mounting.

4 Installation of system components

4.1 Mechanical mounting

The system can be snap-fitted to a DIN rail in accordance with EN 60715 using a mounting adapter. The adapter can be fitted in many different ways. The adapter can be modified so that the system can be mounted at 90° intervals for horizontal (see Figure 5) or vertical (see Figure 6) mounting. Alternatively the mounting adapter can be removed and the backplane mounted directly on a baseplate with four screws.

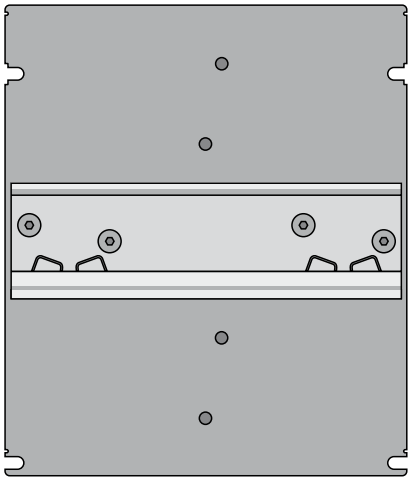


Figure: 5

DIN rail mounting in horizontal position

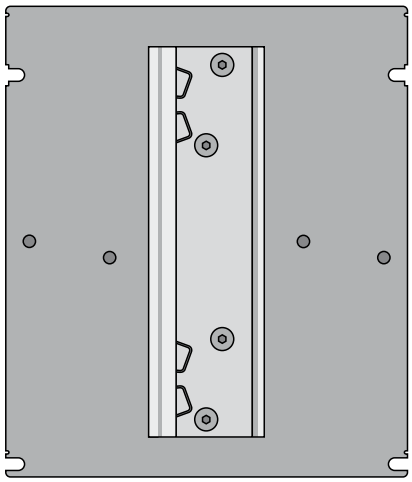


Figure: 6

DIN rail mounting in vertical position

4.1.1 Adapter mounting

The backplane is provided with eight permanently fitted M5 nuts. Four are required to fit the mounting adapter. This requires the use of a size 3 hexagon spanner.

CAUTION

Risk of device damage through incorrect mounting of the adapter on the DIN rail
When mounting ensure that the springs on the adapter are not loaded with the weight of the system.
Fit the adapter so that the weight of the system **DOES NOT** press against the springs (see Figure 7).

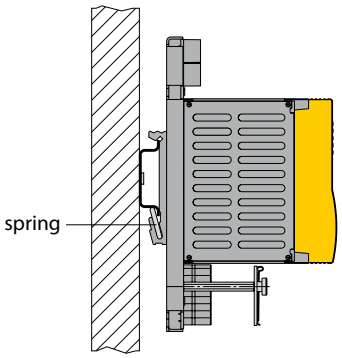


Figure: 7

Correct adapter mounting

4.1.2 Screwing on a baseplate

The backplane can be screwed onto a baseplate directly using 4 screws (not included in delivery).

WARNING

Risk of explosion! Risk of personal injury due to mounting with incorrect screws
When using your own screws ensure that the correct dimensions are observed.
When using your own screws, ensure that these are not longer than 8 mm. Otherwise the PCB may be damaged and explosion protection may no longer be guaranteed.

4.1.3 Affixing labels

The system allows the fixing of labels.
Paper strips for inscription can be inserted in the retainer provided above the connection terminals.
Ready-to-use forms for entering designations/measuring point numbers in Microsoft WORD, MICROSOFT Excel, and as a csv file are available for download at www.turck.com.

Fitting the label cards in the label strip

➤ Undo the two knurled screws to insert the paper label into the label strip.

➤ Then insert the label.

➤ Re-tighten the two knurled screws to secure the paper label.
We recommend the use of waterproof and wipe-proof ink for the inscription.

4.1.4 Hot swapping modules (during operation)

All modules can be fitted or removed (hot swapped) during operation.
Faulty devices can also be exchanged during operation.

The user can code the module rack in such a way that a module can only be replaced by one of the same type. The coding is implemented with hexagonal coding pins that are fitted in the appropriate recesses on the module rack. Each slot has four recesses.

Each module is factory fitted with coding pins (top right and bottom right), two other pins (top left and bottom left) can be fitted by the customer.

On principle also use the customer coding.

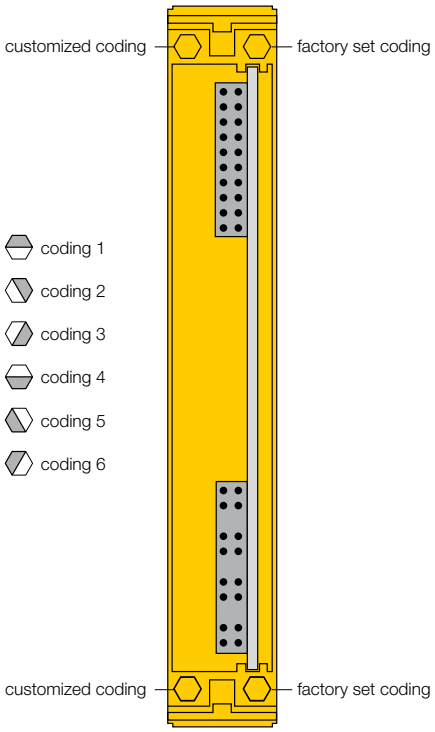


Figure: 8

Codings on the interface module (view of rear of module

CAUTION

Risk of damage to the device due to missing customer coding

Be aware when fitting the modules that the customer coding must also be assigned so that the module cannot be fitted inversely by 180 ° (“on its head”).

The following codings can be used for the modules:

Interface module	Customer coding Top left/bottom left	Factory coding Top right/bottom right
IMB-DI-451Ex-P/24VDC	free / free	Coding 1 / Coding 1
IMB-DO-44Ex-P/24VDC	free / free	Coding 4 / Coding 5
IMB-DO-44Ex-N/24VDC	free / free	Coding 4 / Coding 3
IMB-AI-22Ex-Hi/24VDC	free / free	Coding 2 / Coding 1
IMB-AIA-22Ex-Hi/24VDC	free / free	Coding 2 / Coding 3
IMB-AO-22Ex-Hi/24VDC	free / free	Coding 3 / Coding 3
IMB-TI-RTD-231Ex-HCi/24VDC	free / free	Coding 5 / Coding 5
IMB-TI-TC-231Ex-HCi/24VDC	free / free	Coding 5 / Coding 6

Table: 2
IMB system – Coding of the interface modules

4.2 Electrical connection

4.2.1 Power supply connection

A redundant power supply can be connected via two connectors on the backplane. (see Figure 9)
These allow a maximum cross section of 2.5 mm².
The power supply units do not have to be provided with suppressor circuits.

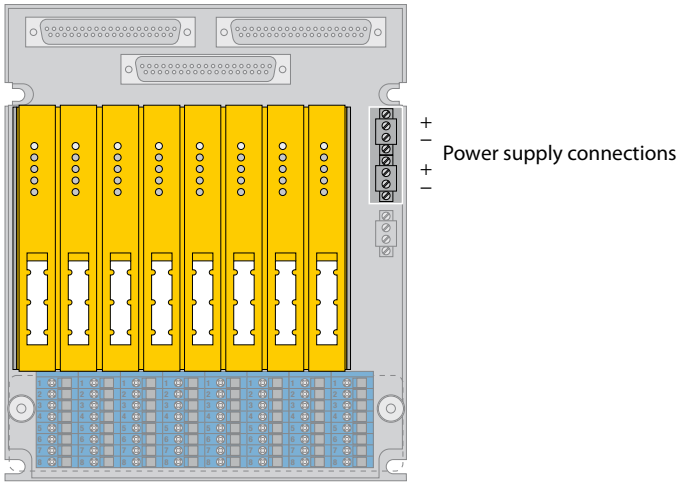


Figure: 9

IMB system – Power supply connection

CAUTION

Risk of damage to the device due to incorrect electrical connection of the power supply
The terminals are not suitable for power supply distribution.
A power supply bus can be installed if several IMB systems are to be fed from one power supply unit.
This consists of two 1.5 mm² cables that are connected via a double ferrule.

NOTE

Deployment of a power supply other than Honeywell
If you use a power supply other than Honeywell to feed the control system, an additional line bridge has to be deployed for proper operation of analog IMB-AI..., IMB-AIA... and IMB-Ti... interface cards.
For this purpose, bridge the minus connection (4–) at the front adapter IMB-FA-H-C300 to the minus connection of the IOTA-TB4.
The power supply of the digital IMB-DI... interface cards must not be connected to the terminals of the IOTA-TB4.

4.2.2 Dimensioning of the power supply units

The IMB system allows the operational power supply to be provided redundantly by two independent power supply units.
The following power requirement can be used as the basis for dimensioning the power supply units for an IMB system.

Two operating states must be taken into account:

Max. power consumption:
This states the maximum power consumption of the interface module. This value has no relation to the standard operating states. For example, it may occur if the operating voltage reaches an unfavorable value and all outputs are short-circuited at the same time. Other effects such as an unfavorable ambient temperature are considered for this operating state, i.e. the classical "worst case" scenario.

Typical power consumption:
The typical power consumption is stated at the rated voltage of 24 VDC required for the simultaneous maximum load on the outputs.

The power is stated for each interface module and must be multiplied for the relevant application by the number of interface modules per module assembly. The value is then the power requirement for one module assembly.

Interface module	Max. power consumption [W]	Typical power consumption [W]	Function	Connected devices
IMB-Di-451Ex-P/24VDC	2	1.546	Isolating switching amplifier	NAMUR sensor
IMB-DO-44Ex-.../24VDC	4.5	2.26	Intrinsically safe power supply/ valve control module	Intrinsically safe solenoid valves/transmitters/ indicator lights
IMB-AI-22Ex-Hi/24VDC	1,2	0.88	Passive HART® input isolator	Externally fed HART® transmitter (4-wire)
IMB-AIA-22Ex-Hi/24VDC	2.1	1.04	HART® isolating transducer	HART® transmitter (2-wire)
IMB-AO-22Ex-Hi/24VDC	2.2	1.4	HART® output isolator	Actuator/ display
IMB-TI-TC-231Ex-HCi/24VDC	2.3	2.1	Temperature measuring amplifier	Thermocouples / temperature resistors/poten-tiometers/ resistors
IMB-TI-RTD-231Ex-HCi/24VDC	3.2	3	Temperature measuring amplifier	Temperature resistors/poten-tiometers/ resistors
IMB-BM	2.3	negligible	Dummy module	–

Table: 3
IMB system – Power data of the interface modules

4.2.3 Alarm connection

The IMB system offers the possibility of passive and active alarms (depending on the device type (see Table 4).

The active alarm evaluation consists of a semiconductor contact on the interface modules.This is switched in the "Good" condition. A semiconductor was selected because this component offers wear-free operation whilst also offering a relatively low voltage drop. The semiconductors are connected in series when the interface module is fitted on the backplane. If 24 VDC is applied to the alarm connector (see Figure 10), an alarm can be read as soon as a fault is detected in the input circuit. This has the advantage that both the removal of a interface module and a power supply failure, as well as a cable fault will cause a fault to be indicated.

The passive alarm signal consists of a bridged connection on the interface modules.
The passive alarm system can thus be used to determine whether all modules are correctly fitted.

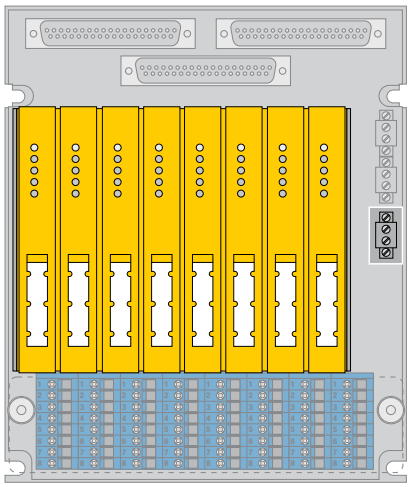


Figure: 10
IMB system – Alarm monitor connection

Interface module	Alarm type	Alarm function
IMB--Di-451Ex-P/24VDC	Active	Fault in input circuit/ short circuit/plug-in control
IMB-DO-44Ex-P(N)/24VDC	Passive	Plug-in control
IMB-AI-22Ex-Hi/24VDC	Passive	Plug-in control
IMB-AIA-22Ex-Hi/24VDC	Passive	Plug-in control
IMB-AO-22Ex-Hi/24VDC	Passive	Plug-in control
IMB-TI-TC-231Ex-HCi/24VDC	Active	Fault in the input circuit/ short-circuit/plug-in control
IMB-TI-RTD-231Ex-HCi/24VDC	Active	Fault in the input circuit/ short-circuit/plug-in control
IMB-BM	Passive	Plug-in control

Table: 4
IMB-System – Alarm function

NOTE

Detecting a wire break or short-circuit on analog input modules (IMB-AI..., IMB-AIA...)
In order to detect a wire break or short-circuit on analog signal modules (IMB-AI...., IMB-AIA....), we recommend the use of the "Live Zero" mode. This enables a cable fault to be detected in the control system by evaluating the 4…20 mA input signal since the analog input interface modules (IMB-AI…, IMB-AIA....) reflect the field current on the control system side.

NOTE

Detecting a wire break or short-circuit on analog output modules (IMB-AO....)
In the event of a wire break or short-circuit, the IMB-AO... switches the analog input circuits to a high impedance state. The input current is thus always outside of the applicable value range in accordance with NE 43. In this way, the faults of the connected controller can be detected.
No distinction is made between wire break and short-circuit.

The dummy module (IMB-BM) is also provided with a passive alarm system, since this is absolutely necessary due to the requirement for IP20 when there are empty slots.

NOTE

Activation of an alarm due to empty slots not being filled with IMB-BM dummy module
The alarm is activated if the empty slots are not filled with the IMB-BM dummy module.

4.2.4 Control system connection

The backplane is provided with three slots for system cables (see Figure 11). The upper two are designed for connecting digital signals, the lower one is designed for analog signals. The backplane IMB-BP-8H-IN can be used for analog and for digital input signals and the backplane IMB-BP-8H-OUT can be used for analog and for digital output signals.
The fitted digital or analog modules therefore determine the function of the system.

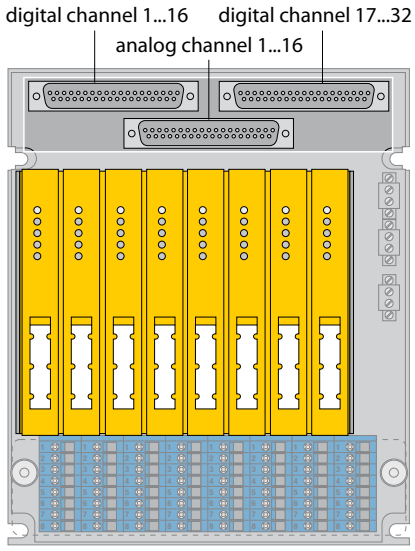


Figure: 11
IMB system – Control system connection

The deployment of the corresponding backplane depends on the signal type:

Signal type	Interface module	Backplane
Digital NAMUR input	IMB-DI-451Ex-P/24VDC	IMB-BP-8H-IN
Analog active input	IMB-AIA-22Ex-Hi/ 24VDC	IMB-BP-8H-IN
Analog passive input	IMB-AI-22Ex-Hi/24VDC	IMB-BP-8H-IN
Analog output	IMB-AO-22Ex-Hi/24VDC	IMB-BP-8H-OUT
Digital output	IMB-DO-44Ex/24VDC	IMB-BP-8H-OUT
Temperature RTD	IMB-TI-RTD-231Ex-Hi/24VDC	IMB-BP-8H-IN
Temperature Thermocouple	IMB-TI-TC-231Ex-Hi/24VDC	IMB-BP-8H-IN
IMB-BM	Passive	Plug-in control

Table: 5
IMB-System – Application of the corresponding backplane

4.2.5 Field connection

The field terminals provide the connection for the intrinsically safe signals (see Figure 12). Intrinsically safe circuits must be identifiable. The terminals are therefore light blue in color. The terminals can take cable cross sections of up to 2.5 mm^2 with ferrules.

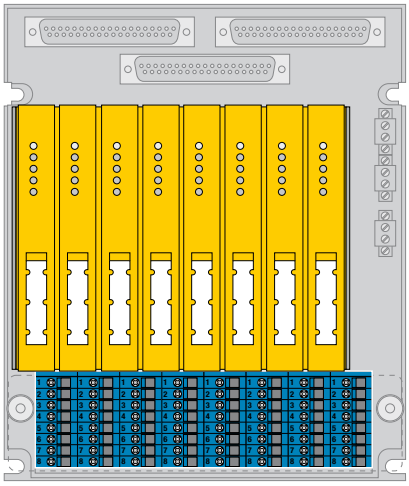


Figure: 12
IMB system – Field connection

WARNING

Risk of explosion! Risk of personal injury due to insufficient identification of intrinsically safe circuits
Ensure the unique identification of intrinsically safe circuits in accordance with EN 60074-11.
The identification of intrinsically safe circuits with light blue cables, terminals and cable bushings has established itself as standard practice and is recommended by TURCK.

➤ To connect the terminal chamber fully undo the screw by turning it anticlockwise.

➤ Then insert the cable against the pressure of the terminal springs until the dead stop is reached.

➤ Tighten the screw to fasten the cables.

NOTE

Using ferrules with collars and carrying out a strain relief test
We recommend the use of ferrules with collars. This prevents accidental cross connections and short-circuits due to loose leads.
We also recommend a strain relief test in order to ensure a durable electrical connection.

4.2.6 Ground connection and shield connection

If a ground and shield connection is required, the ground or shield can be connected with ring or fork cable lugs to a terminal provided for it (see Figure 13).

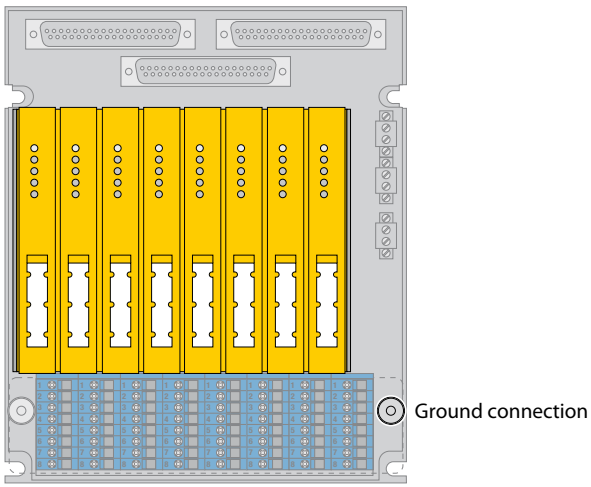


Figure: 13
IMB system – Ground connection

5 Features of the interface modules

5.1 General interface module features

- Each interface module is provided with an LED for indicating operational readiness.
- All modules can be fitted and removed with the power supply switched on ("hot swapping").
- All interface modules are short-circuit proof and open-circuit proof.

This provides optimum flexibility during the commissioning phase and also during maintenance tasks.

5.2 Alarm monitor

NOTE

Removing a module triggers the alarm

The IMB-DI-451Ex-P/24VDC digital input modules also trigger an alarm when a NAMUR sensor has not yet been connected. TURCK also offers a resistor module (type WM1, Ident no. 0912101)

5.3 Explosion protection

The testing of the observance of intrinsic safety is indispensable in order to create a system made up of intrinsically safe and associated equipment. The compatibility of the safety parameters of the associated equipment with those of the intrinsically safe equipment must be examined (see also chapter 2.4, page 15, and the calculation example chapter 5.3.3, page 33). The cable length of the intrinsically safe connection also has an effect on this test.

5.3.1 Approvals of the interface modules

Signal type	Associated equipment	ATEX approval	GOST approval	IECEx approval	FM approval
Digital NAMUR input	IMB-DI-451Ex-P/24VDC	TÜV 08 ATEX 554880	Yes	IECEx TUN 10.0021	Pending
Analog active input	IMB-AIA-22Ex-Hi/24VDC	TÜV 09 ATEX 554881	Yes	IECEx TUN 10.0010	Pending
Analog passive input	IMB-AI-22Ex-Hi/24VDC	TÜV 09 ATEX 554858	Yes	IECEx TUN 10.0016	Pending
Analog output	IMB-AO-22Ex-Hi/24VDC	TÜV 09 ATEX 555612	Yes	IECEx TUN 10.0015	Pending
Digital output	IMB-DO-44Ex.../24VDC	TÜV 09 ATEX 555410	Yes	IECEx TUN 10.0022	Pending
Temperature resistor	IMB-TI-RTD-231Ex-HCi/24VDC	TÜV 10 ATEX 556047	Yes	IECEx TUN 10.0008	Pending
Temperature thermocouple	IMB-TI-TC-231Ex-HCi/ 24VDC	TÜV 10 ATEX 556047	Yes	IECEx TUN 10.0008	Pending
IMB-BM dummy module	Passive	Plug-in control	–	–	–

Table: 6
Interface modules – Overview approvals

5.3.2 List of Ex parameters in accordance with ATEX

Associated equipment	ATEX approval	U_o [V]	U_i [mA]	I_o [mA]	I_i [mA]	P_o [mW]	P_i [mW]	L_i* [µH]	C_i* [nF]	L_o* [mH]	C_o* [µF]
IMB-DI-451Ex-P/24VDC	TÜV 08 ATEX 554880	12	–	12.4	–	37.2	–	76.5	–	10/ 0.92	0.49,/ 0.78
IMB-AIA-22Ex-Hi/24VDC	TÜV 09 ATEX 554881	23	–	64.5	–	799	–	76.5	22	0.804/ 0.424/ 0.024	0.046/ 0.062/ 0.121
IMB-AI-22Ex-Hi/24VDC	TÜV 09 ATEX 554858	–	27	–	150	–	1000	–	–	–	–
IMB-AO-22Ex-Hi/24VDC	TÜV 09 ATEX 555612	25	–	49	–	760	–	–	–	0.5/ 0.2	0.087/ 0.11
IMB-DO-44Ex..../24VDC	TÜV 09 ATEX 555410	21.2	–	75.3	–	898	–	–	–	12	0.62
IMB-TI-RTD-231Ex- HCi/24VDC	TÜV 10 ATEX 556047	5	–	5	–	6.2	–	73	–	100/ 10/ 1	1.8/ 2.4/ 3.4
IMB-TI-TC-231Ex- HCi/24VDC	TÜV 10 ATEX 556047	5	–	5	–	6.2	–	73	–	100/ 10/ 1	1.8/ 2.4/ 3.4

Table: 7
Interface modules – Ex parameters according to ATEX

* For explosion group IIC (except IMB-DO-44Ex.../24VDC: explosion group IIB applicable)

NOTE

EC type examination certificates from page 117 and on the Internet
The EC type examination certificates are listed from page 117 and can also be downloaded from the TURCK website at www.turck.com.

5.3.3 Verification of intrinsic safety/example

The EC type examination certificate of a sensor specifies the maximum permissible input values (Input):

U_i = 20 VDC
I_i = 60 mA
P_i = 200 mW
Ci = 150 nF
L_i = 150 µH

The certificate for the isolating switching amplifier specifies the output values (Output):

U_o < 9.6 VDC
I_o < 9.6 mA
P_o < 26 mW
C_o < 1.1 µF
L_o < 1 mH

The verification of intrinsic safety requires the following ratios:

$U_o < U_i$
$I_o < I_i$
P_o < Pi

If distributed reactances are present or if C_i and $L_i \leq 1$ % of C_o or L_o, the following ratios apply:
$C_o > C_i + C_I$
$L_o > L_i + L_I$

Voltage testing

9.6 V < 20 VDC = OK

Current testing

9.6 mA < 60 mA = OK

Power testing

26 mW < 200 mW = OK

Capacitance testing

1.1 µF > 150 nF + 55 nF (assumed value for 500 m cable length) = 215 nF = OK

Inductance testing

1 mH > 150 µH + 0.5 mH (assumed value for 500 m cable length) = 0.650 mH = OK

5.4 Channel assignment of the interface modules at the field terminals

5.4.1 Overview of the channel assignment of the analog modules

- IMB-AI-22Ex-Hi/24VDC / IMB-AIA-22Ex-Hi/24VDC
- IMB-AO-22Ex-Hi/24VDC

Ch. 1	11	+	Ch. 3	21	+	Ch. 5	31	+	Ch. 7	41	+	Ch. 9	51	+	Ch. 11	61	+	Ch. 13	71	+	Ch. 15	81	+
	12	–		22	–		32	–		42	–		52	–		62	–		72	–		82	–
Ch. 2	13	+	Ch. 4	23	+	Ch. 6	33	+	Ch. 8	43	+	Ch. 10	53	+	Ch. 12	63	+	Ch. 14	73	+	Ch. 16	83	+
	14	–		24	–		34	–		44	–		54	–		64	–		74	–		84	–

Figure: 14
Channel assignment of the analog modules

5.4.2 Overview of the channel assignment of the temperature modules

- IMB-TI-RTD-231Ex-HCi/24VDC

Ch. 1	11	Ch. 3	21	Ch. 5	31	Ch. 7	41	Ch. 9	51	Ch. 11	61	Ch. 13	71	Ch. 15	81	RTD +
	12		22		32		42		52		62		72		82	RTD + Sense
	13		23		33		43		53		63		73		83	RTD – Sense
	14		24		34		44		54		64		74		84	RTD –
Ch. 2	15	Ch. 4	25	Ch. 6	35	Ch. 8	45	Ch. 10	55	Ch. 12	65	Ch. 14	75	Ch. 16	85	RTD +
	16		26		36		46		56		66		76		86	RTD + Sense
	17		27		37		47		57		67		77		87	RTD – Sense
	18		28		38		48		58		68		78		88	RTD –

Figure: 15
Channel assignment of the analog module temperature module IMB-TI-RTD-231Ex-HCi/24VDC

- IMB-TI-TC-231Ex-HCi/24VDC

Ch. 1	11	Ch. 3	21	Ch. 5	31	Ch. 7	41	Ch. 9	51	Ch. 11	61	Ch. 13	71	Ch. 15	81	TC – / RTD +
	12		22		32		42		52		62		72		82	TC +
	13		23		33		43		53		63		73		83	RTD – Sense
	14		24		34		44		54		64		74		84	RTD –
Ch. 2	15	Ch. 4	25	Ch. 6	35	Ch. 8	45	Ch. 10	55	Ch. 12	65	Ch. 14	75	Ch. 16	85	TC – / RTD +
	16		26		36		46		56		66		76		86	TC +
	17		27		37		47		57		67		77		87	RTD – Sense
	18		28		38		48		58		68		78		88	RTD –

Figure: 16
Channel assignment of the analog module temperature module IMB-TI-TC-231Ex-HCi/24VDC

5.4.3 Overview of the channel assignment of the digital modules

- IMB-DI-451Ex-P/24VDC
- IMB-DO-44Ex-P/24VDC / IMB-DO-44Ex-N/24VDC

Ch. 1	11	+	Ch. 5	21	+	Ch. 9	31	+	Ch. 13	41	+	Ch. 17	51	+	Ch. 21	61	+	Ch. 25	71	+	Ch. 29	81	+
	12	–		22	–		32	–		42	–		52	–		62	–		72	–		82	–
Ch. 2	13	+	Ch. 6	23	+	Ch. 10	33	+	Ch. 14	43	+	Ch. 18	53	+	Ch. 22	63	+	Ch. 26	73	+	Ch. 30	83	+
	14	–		24	–		34	–		44	–		54	–		64	–		74	–		84	–
Ch. 3	14	+	Ch. 7	25	+	Ch. 11	35	+	Ch. 15	45	+	Ch. 19	55	+	Ch. 23	65	+	Ch. 27	75	+	Ch. 31	85	+
	16	–		26	–		36	–		46	–		56	–		66	–		76	–		86	–
Ch. 4	17	+	Ch. 8	27	+	Ch. 12	37	+	Ch. 16	47	+	Ch. 20	57	+	Ch. 24	67	+	Ch. 28	77	+	Ch. 32	87	+
	18	–		28	–		38	–		48	–		58	–		68	–		78	–		88	–

Figure: 17
Channel assignment of the digital modules

5.5 Use of the HART® protocol with the IMB system

TECHNICAL INFORMATION

HART® protocol

HART® (Highway Addressable Remote Transducer) is a digital protocol that is superimposed on the analog 4…20 mA signal. This protocol makes it possible to exchange other data with the field device in addition to the measured value. A frequency signal is modulated on the analog measuring signal. Two frequencies are used, one at 1.2 kHz representing logic "1" and one at 2.2 kHz representing logic "0". This enables the sending of digitally coded messages. The messaging principle is called FSK (Frequency Shift Keying) or Bell 202.

As the current signal is used as the carrier, a minimum current of 1 mA must be present.

5.5.1 HART® transparent modules

The analog dual-channel input and output interface modules allow communication from the control system to the field device. The FSK signals are transmitted in the frequency range up to 2.2 kHz. It is also possible to make settings directly on the field device using an Ex-compatible HART® handheld device. The HART® interface modules (HART®-friendly) are also suitable for this. The IMB-TI... plug-in temperature modules can also be addressed as HART® devices via the current interface.

Interface module	Function	HART® specification
IMB-AIA-22Ex-Hi/24VDC	Analog active input	transparent, HART®-friendly
IMB-AI-22Ex-Hi/24VDC	Analog passive input	transparent, HART®-friendly
IMB-AO-22Ex-Hi/24VDC	Analog active output	transparent, HART®-friendly
IMB-TI-RTD-231Ex-HCi/24VDC	Temperature measuring via temperature resistors	parameterizable
IMB-TI-TC-231Ex-HCi/24VDC	Temperature measuring via thermocouples and temperature resistors	parameterizable

Table: 8
HART® transparent modules

5.5.2 HART® multiplexer connection

A HART® multiplexer system can be connected for convenient remote parameter assignment. This has the advantage that maintenance personnel can parameterize and maintain every transmitter without having to go to it directly in the field.

A common database can also be created which can be managed centrally for the entire installation.

In most applications, the multiplexed data is provided on a maintenance system. This maintenance system exists in parallel to the control computer.

In this way, maintenance personnel can access the measurement and control parameters of transmitters and interface devices at any time.

A HART® multiplexer can also directly access the cables on the system plug connector. For this the multiplex connector is fitted on the analog slot. A Y connector must be used as an adapter (see also chapter 2.9, page 17).

5.6 Field connection

The field connection is normally implemented via individual conductors. The IMB system is provided with screw terminals for each individual conductor. The terminal row assigned to the channels is located underneath the relevant slot.
The position of the channel on the terminal row is the same as the position of the corresponding channel LED on the interface modules.

5.7 Channel distribution of the field connection

5.7.1 IMB-Di-451Ex-P/24VDC

Terminal	Associated channel
1	Channel 1 +
2	Channel 1 –
3	Channel 2 +
4	Channel 2 –
5	Channel 3 +
6	Channel 3 –
7	Channel 4 +
8	Channel 4 –

Table: 9
Channel distribution of IMB-DI-451Ex-P/24VDC

5.7.2 IMB-AI-22Ex-Hi/24VDC

Terminal	Associated channel
1	Channel 1 +
2	Channel 1 –
3	Channel 2 +
4	Channel 2 –
5	Not used
6	Not used
7	Not used
8	Not used

Table: 10
Channel distribution of IMB-AI-22Ex-Hi/24VDC

5.7.3 IMB-AIA-22Ex-Hi/24VDC

Terminal	Associated channel
1	Channel 1 +
2	Channel 1 –
3	Channel 2 +
4	Channel 2 –
5	Not used
6	Not used
7	Not used
8	Not used

Table: 11
Channel distribution of IMB-AIA-22Ex-Hi/24VD

5.7.4 IMB-AO-22Ex-Hi/24VDC

Terminal	Associated channel
1	Channel 1 +
2	Channel 1 –
3	Channel 2 +
4	Channel 2 –
5	Not used
6	Not used
7	Not used
8	Not used

Table: 12
Channel distribution of IMB-AO-22Ex-Hi/24VDC

5.7.5 IMB-TI-RTD-231Ex-HCi/24VDC

Terminal	Associated channel
1	Channel 1, RTD +
2	Channel 1, RTD + Sense
3	Channel 1, RTD – Sense
4	Channel 1, RTD –
5	Channel 2, RTD +
6	Channel 2, RTD + Sense
7	Channel 2, RTD – Sense
8	Channel 2, RTD –

Table: 13
Channel distribution of IMB-TI-RTD-231Ex-HCi/24VDC

5.7.6 IMB-TI-TC-231Ex-HCi/24VDC

Terminal	Associated channel
1	Channel 1, TC – /RTD +
2	Channel 1, TC +
3	Channel 1, RTD – Sense
4	Channel 1, RTD –
5	Channel 2, TC – /RTD +
6	Channel 2, TC +
7	Channel 2, RTD – Sense
8	Channel 2, RTD –

Table: 14
Channel distribution of IMB-TI-TC-231Ex-HCi/24VDC

5.7.7 IMB-DO-44Ex.../24VDC

Terminal	Associated channel
1	Channel 1+
2	Channel 1 –
3	Channel 2+
4	Channel 2 –
5	Channel 3+
6	Channel 3 –
7	Channel 4+
8	Channel 4 –

Table: 15
Channel distribution of IMB-DO-44Ex.../24VDC

5.8 Evaluation process for determining functional safety – SIL

The digital and analog interface modules of the IMB series are evaluated in accordance with IEC 61508 and are classified to SIL.

TECHNICAL INFORMATION

SIL evaluation process

SIL (Safety Integrated Level) is an evaluation process for determining functional safety. The procedure is based on IEC 61508. The standard is the basis from which the IEC 61511 standard for measurement and control technology arose. The standard covers control loops that are created with different devices. A control loop can consist of a sensor, interface devices and an actuator. If the risk analysis in accordance with IEC 61508 has determined that a safety assessment is required, the SIL devices compliant with a specific SIL/class must be used.

The evaluation of the IMB interface devices has provided characteristic values that were determined in a device assessment.

NOTE

SIL certificates from page 105 and on the Internet

The SIL certificates are available from page 105. However, these can also be downloaded from the TURCK website at www.turck.com.

5.8.1 SIL values of the individual IMB interface modules

Interface	SIL classification	SFF	DC_D	MTBF
IMB-DI-451Ex-P/24VDC	SIL2	83 %	0 %	232 years
IMB-AIA-22Ex-Hi/24VDC	SIL2	87 %	81 %	271 years
IMB-AI-22Ex-Hi/24VDC	SIL3	94 %	91 %	301 years
IMB-AO-22Ex-Hi/24VDC	SIL3	92 %	0 %	164 years
IMB-DO-44Ex.../24VDC	SIL3	97 %	0 %	192 years
IMB-TI-RTD-231Ex-HCi/24VDC	SIL 2	91 %	91 %	110 years
IMB-TI-TC-231Ex- HCi/24VDC	SIL 2	91 %	91 %	110 years

Table: 16
Interface modules – SIL values

6 Operating the interface modules

6.1 IMB-DI-451Ex-P/24VDC isolating switching amplifier

The four-channel isolating switching amplifiers are used for the galvanically isolated transmission of binary switch states. Sensors compliant with EN 60947-5-6 or mechanical sensors located in the Ex area can be connected to the intrinsically safe input circuits. The input circuits are galvanically isolated from the output circuits, from the power supply and between each other. The switch outputs of all channels on the IMB-Di-451Ex-P/24VDC are permanently set to normally open operation (NO).

NOTE

Deployment of a power supply other than Honeywell

The power supply of the digital IMB-DI... interface cards must not be connected to the terminals of the IOTA-TB4.

6.1.1 LED indication

When lit, the green "Pwr" LED indicates operational readiness. The IMB-DI-451Ex-P/24VDC interface modules are provided with full status indication by the LEDs 1...4 assigned to each channel (see table 17).

Figure: 18
IMB-DI-451Ex-P/24VDC isolating switching amplifier

This allows the indication of the following states:

LED	Input active	Input inactive	Active alarm signal
1...4	Off	Yellow lit	Red lit

Table: 17
LED states of the IMB-Di-451Ex-P/24VDC

6.1.2 Block diagram IMB-DI-451Ex-P/24VDC

The power supply (+) of the transistor outputs is looped through inside the device!

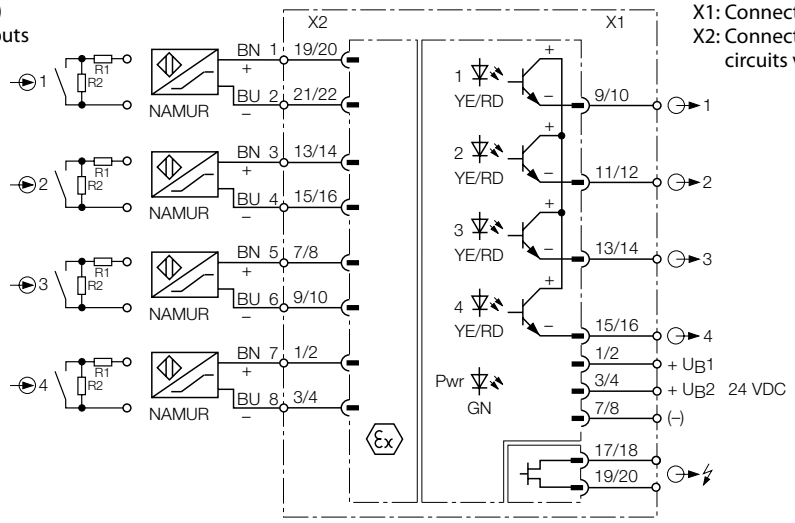


Figure: 19
Block diagram of the IMB-DI-451Ex-P/24VDC

6.1.3 NAMUR input circuits

The digital inputs of the IMB system can be connected to sensors compliant with EN 60947-5-6 (NAMUR).

TECHNICAL INFORMATION

NAMUR sensors

NAMUR sensors are current loop sensors in accordance with NAMUR NA 001. The term "NAMUR" is the name of an interest group of users in the chemical industry. (NAMUR stands for "Normen und Arbeitsausschuss Mess- und Regeltechnik" – Standards and work committee for instrumentation and control technology, present name: Automation Systems Interest Group of the Process Industry). NAMUR is the leading technology for process automation.
The benefit of this application is the fact that only two wires are required. The signal strength is also so low that the signal can be used in intrinsic safety applications for explosion protection. By evaluating predefined current levels, it is possible to detect a wire break or a short-circuit on the cable route to the sensor.

The characteristic curve shows the current depending on the distance of the sensor from the damping element (see Figure 20). Be aware that characteristic curve can differ from the one shown, depending on the switching distance and the damping material.
The nominal switching distance (sn) of a NAMUR sensor is based on damping with the standard damping element. This is an ST37 steel plate. Other materials than the ST37 steel plate may have a correction factor. Depending on the installation conditions, a pre-damping may occur by surrounding material. In extreme cases, this may mean that the switching threshold at 1.75 mA and 1.55 mA is not exceeded at all.
The maximum permissible cable resistance is 50 Ω.

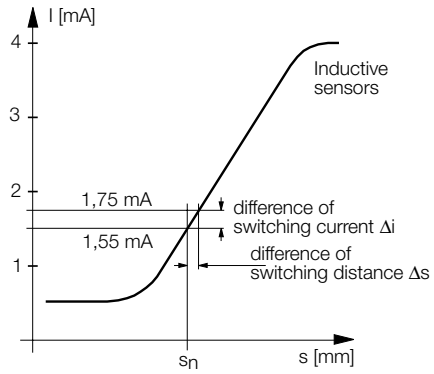


Figure: 20
NAMUR curve

6.1.4 Cable resistance

EN 60947-5-6 allows the use of cable resistances up to 50 Ω.
The permissible length of a cable is calculated as follows:

$l = A \times R / \varsigma$ in which:
(l: length in meters)
(A: cross sectional area mm^2)
(ς: specific resistance in $(\Omega \times mm^2) / m$ (copper: 0.01724)

Example:

l is required for a 0.75 mm^2 cable:

$l = (A \times R) / \varsigma = (0.75mm^2 \times 50\ \Omega) / 0.01724 = 2175$ m

As the feed and return cable must be allowed for, the resulting length is: 1088 m

The transfer resistances of terminals are not included in this calculation.

As these are known to normally increase over time a safety factor must be included in the calculation.

6.1.5 Dimensioning and installation of NAMUR sensors – Technical implementation

TECHNICAL INFORMATION

Internal connection of NAMUR sensors in the switching amplifier
The Namur sensor is fed via a constant voltage source. The voltage drop is measured across a 1 kΩ resistor to ground. If the open circuit voltage is measured when the sensor is not connected, this will be 8.2 V. This voltage will change according to the operating state of the sensor as it is a voltage divider circuit with the sensor and the 1 kΩ resistor connected in series (see Figure 21). All TURCK sensors have externally the same switching distances and cable tolerances.

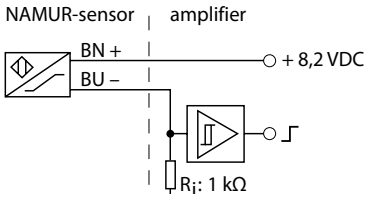


Figure: 21

Dimensioning and mounting – technical implementation

6.1.6 Wire break and short-circuit detection

The EN 60947-5-6 (NAMUR) standard stipulates limit values for detecting cable faults. The isolating switch amplifier detects a short-circuit if the current exceeds the limit value of 6 mA.
A wire break is detected if the current goes below 0.1 mA. In both cases, the output of the TURCK isolating switching amplifier is switched off (transistor inhibited etc.).
Conversely, this means that the fault indication has to be suppressed if the sensor is not connected.

NOTE

Use of the WM1 module with only partial utilization of the IMB-DI-... interface module
Be aware that if the IMB-DI-... interface module is only partially used, the unused channels must be fitted with a TURCK resistor module WM1 (Ident no. 0912101) for fault suppression.

6.1.7 Connecting a sensor

TURCK proximity switches are available in a wide range of mounting forms and with a wide range of operating principles.
Devices with a terminal chamber, M12 x 1 plug connection and also in cabled versions are available.

NOTE

Polarity of NAMUR sensors
Ensure that NAMUR sensors are connected with the correct polarity.
Devices with cables are provided with appropriate core colors:
Brown corresponds to + and blue corresponds to –

NOTE

TURCK NAMUR sensors
The "Y1" and "Y0" in the type code of TURCK sensors indicate the NAMUR operating principle.

6.1.8 Connecting a mechanical contact

Mechanical contacts can also be scanned with the digital input interface module.
For example, these are contained in operating elements such as pushbutton actuators or switches, or also in mechanical end position switches. These elements can only take on two switching states. Current flows when closed, and there is accordingly no current when the contact is open. This would therefore keep the isolating switching amplifier permanently in the fault state. A resistor circuit is available in order to prevent this.

The TURCK resistor module WM1 (Ident no. 0912101) is therefore also suitable for monitoring cables to mechanical contacts for wire breaks and short-circuits (see Figure 22). For this the resistor module must be fitted as close to the mechanical contact as possible.

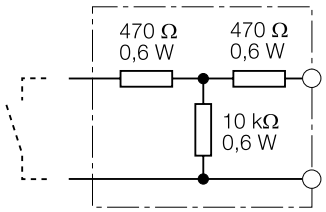


Figure: 22
Internal circuitry of the TURCK WM1 resistor module

6.1.9 Field connection

Terminal	Associated channel
1	Channel 1 +
2	Channel 1 –
3	Channel 2 +
4	Channel 2 –
5	Channel 3 +
6	Channel 3 –
7	Channel 4 +
8	Channel 4 –

Table: 18
Field connection of the IMB-DI-451Ex-P/24VDC

6.1.10 Safety parameters

Associated equipment	ATEX approval	U_o [V]	U_i [mA]	I_o [mA]	I_i [mA]	P_o [mW]	P_i [mW]	L_i* [µH]	C_i* [nF]	L_o* [mH]	C_o* [µF]
IMB-DI-451Ex-P/24VDC	TÜV 08 ATEX 554880	12	–	12,4	–	37,2	–	76,5	–	10/ 0,92	0,49,/ 0,78

Table: 19
Safety parameters of the IMB-DI-451Ex-P/24VDC

* for explosion group IIC

6.1.11 Functional Safety – SIL values

Interface	SIL classification	SFF	DC_D	MTBF
IMB-DI-451Ex-P/24VDC	SIL2	83 %	0 %	232 years

Table: 20
SIL values of the IMB-Di-451Ex-P/24VDC

6.1.12 Alarm monitor function

The module is provided with both passive and active alarm functions. The alarm indication is not switched to "Good" until no other faults are present and all slots are occupied. The active alarm function is implemented with a MOSFET (semiconductor module) (see Figure 23). If the module is fitted (passive alarm) and there is no cable fault present, the MOSFET is switched. This means that 24 VDC is present at the alarm output which indicates a fault-free state. If the rack is not to be fully fitted with function modules, dummy modules (IMB-BM, Ident no.7570007).

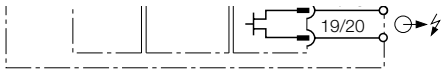


Figure: 23

Block diagram of the active alarm monitor

6.1.13 Application example

The IMB-DI-451Ex-P/24VDC four-channel input interface module is suitable for connecting two dual sensors. These sensors are suitable for detecting the "Open / Closed" positions of ball valves and flaps. One sensor detects the "Closed" position and one the "Open" position of the rotary actuator. A blockage is assumed if a switching operation is not detected within a specified setting time.

Figure: 24

Connecting a dual sensor to IMB-DI-451Ex-P/24VDC

6.2 IMB-AI-22Ex-Hi/24VDC analog signal transmitter

The IMB-AI-22Ex-Hi/24VDC dual-channel analog signal transmitter is used to transfer normalized active voltage or current signals that are galvanically isolated from the Ex area to the safe area.
The digital signals of the HART® communication technology can be transferred bidirectionally in addition to the analog signals. The device is provided with two 0/4...20 mA input circuits and two short-circuit-proof 0/4...20 mA output circuits. The input circuits are galvanically isolated from the output circuits, from the power supply and between each other. The input signals are transferred without attenuation and are presented to the relevant outputs in the safe area. The module is provided with a passive alarm function. The alarm indication is thus not switched to "Good" until all slots are occupied.

NOTE

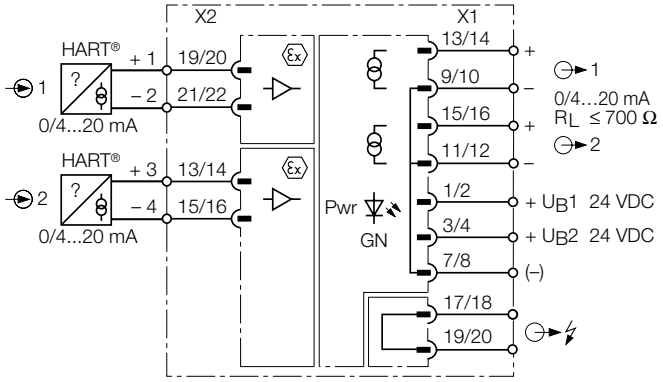
Deployment of a power supply other than Honeywell
If you use a power supply other than Honeywell to feed the control system, an additional line bridge has to be deployed for proper operation of analog IMB-AI-22Ex-Hi/24VDC interface cards. For this purpose, bridge the minus connection (4–) at the front adapter IMB-FA-H-C300 to the minus connection of the IOTA-TB4.

6.2.1 LED indication

When lit, the green "Pwr" LED indicates operational readiness..

Figure: 25
IMB-AI-22Ex-Hi/24VDC analog signal transmitter

6.2.2 Block diagram of the IMB-AI-22Ex-Hi/24VDC



X1: Connection to the backplane
X2: Connection to the input circuits via screw terminals

Figure: 26
Block diagram of the IMB-AI-22Ex-Hi/24VDC

6.2.3 Field connection

Terminal	Associated channel
1	Channel 1 +
2	Channel 1 –
3	Channel 2 +
4	Channel 2 –
5	Not used
6	Not used
7	Not used
8	Not used

Table: 21:
Field connection of the IMB-AI-22Ex-Hi/24VDC

6.2.4 Safety parameters

Associated equipment	ATEX approval	U_o [V]	U_i [mA]	I_o [mA]	I_i [mA]	P_o [mW]	P_i [mW]	L_i* [µH]	C_i* [nF]	L_o* [mH]	C_o* [µF]
IMB-AI-22Ex-Hi/24VDC	TÜV 09 ATEX 554858	–	27	–	150	–	1000	–	–	–	–

Table: 22
Safety parameters of the IMB-AI-22Ex-Hi/24VDC

* for explosion group IIC

6.2.5 Functional Safety – SIL values

Interface	SIL classification	SFF	DC_D	MTBF
IMB-AI-22Ex-Hi/24VDC	SIL3	94 %	91 %	301 years

Table: 23.
SIL values of the IMB-AI-22Ex-Hi/24VDC

6.2.6 Application example

A four-wire transmitter is provided with a 24 VDC power supply by an external power supply unit with protection type Ex d. An intrinsically safe measuring signal is transferred. For this the transmitter is provided with an intrinsically safe active output. The input of the IMB-AI-22Ex-Hi/24VDC is therefore passive (see Figure 27).

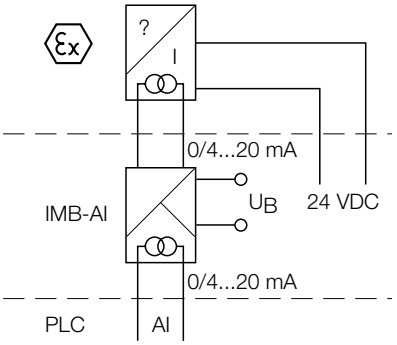


Figure: 27
Application example for IMB-AI-22Ex-Hi/24VDC

6.3 IMB-AIA-22Ex-Hi/24VDC HART® isolating transducer

The IMB-AIA-22Ex-HI/24VDC HART® dual-channel isolating transducer is used to run intrinsically safe HART® two-wire measuring transducers in the Ex area and to transfer the measuring signal to the safe area. The digital signals of the HART® communication technology can be transferred bidirectionally in addition to the analog signals. The device is provided with two 4...20 mA input and two 4...20 mA output circuits. The input circuits are galvanically isolated from the output circuits, from the power supply and between each other. The input signal is transferred 1:1 without attenuation and is presented at the output in the safe area. The 1:1 transmission enables wire breaks or short-circuits to be indicated as currents of 0 mA or > 22.5 mA. The module is provided with a passive alarm function. The alarm indication is thus not switched to "Good" until all slots are occupied.

NOTE

Deployment of a power supply other than Honeywell

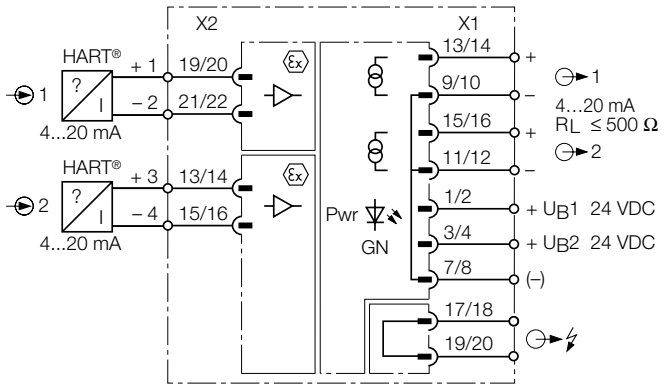
If you use a power supply other than Honeywell to feed the control system, an additional line bridge has to be deployed for proper operation of analog IMB-AI-22Ex-Hi/24VDC interface cards. For this purpose, bridge the minus connection (4–) at the front adapter IMB-FA-H-C300 to the minus connection of the IOTA-TB4.

6.3.1 LED indication

When lit, the green "Pwr" LED indicates operational readiness.

Figure: 28
IMB-AIA-22Ex-Hi/24VDC isolating transducer

6.3.2 Block diagram of the IMB-AIA-22Ex-Hi/24VDC



X1: Connection to the backplane
X2: Connection to the input circuits via screw terminals

Figure: 29
Block diagram of the IMB-AIA-22Ex-Hi/24VDC

6.3.3 Field connection

Terminal	Associated channel
1	Channel 1 +
2	Channel 1 –
3	Channel 2 +
4	Channel 2 –
5	Not used
6	Not used
7	Not used
8	Not used

Table: 24
Field connection of the IMB-AIA-22Ex-Hi/24VD

6.3.4 Safety parameters

Associated equipment	ATEX approval	U_o [V]	U_i [mA]	I_o [mA]	I_i [mA]	P_o [mW]	P_i [mW]	L_i* [µH]	C_i* [nF]	L_o* [mH]	C_o* [µF]
IMB-AIA-22Ex-Hi/24VDC	TÜV 09 ATEX 554881	23	–	64,5	–	799	–	76,5	22	0,804/ 0,424/ 0,024	0,046/ 0,062/ 0,121

Table: 25
Safety parameters of the IMB-AIA-22Ex-Hi/24VDC

* for explosion group IIC

6.3.5 Functional Safety – SIL values

Interface	SIL classification	SFF	DC_D	MTBF
IMB-AIA-22Ex-Hi/24VDC	SIL2	87 %	81 %	271 years

Table: 26
SIL values of the IMB-AIA-22Ex-Hi/24VDC

6.3.6 Application example

A two-wire transmitter is fed with the IMB-AIA-22Ex-Hi/24VDC with protection type Ex i via a phantom power supply. The 4…20 mA measuring signal is transferred as an intrinsically safe signal. The input of the IMB-AIA... is therefore active (see Figure 30).

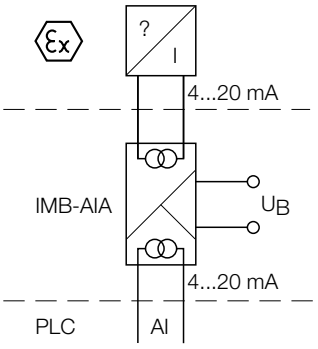


Figure: 30
Application example for IMB-AIA-22Ex-Hi/24VDC

6.4 IMB-AO-22Ex-Hi/24VDC signal isolator

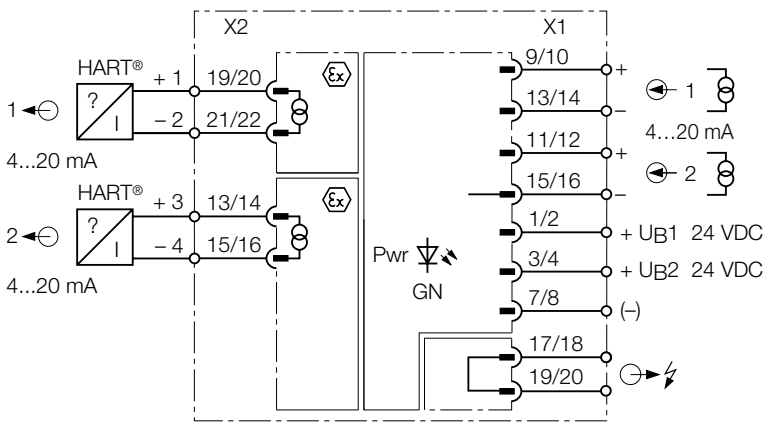
The normalized current signal is galvanically isolated and transmitted via the IM35-22EX-HI/24VDC dual-channel signal isolator from the safe to the Ex area without attenuation (1:1).
The device is provided with two 4...20 mA input and two 4...20 mA output circuits. In addition to the analog signals, digital HART® communication signals can be transferred bidirectionally.
Typical applications are for example, the control of I/P converters (e.g. at control valves) or indicators in the Ex area. The actuators are connected to the output terminals.
In the event of a wire break or short-circuit in the measuring transducer circuit, the analog input circuits switch to a high impedance state. The module is provided with a passive alarm function. The alarm indication is thus not switched to "Good" until all slots are occupied.

6.4.1 LED indication

When lit, the green "Pwr" LED indicates operational readiness.

Figure: 31
IMB-AO-22Ex-Hi/24VDC signal isolator

6.4.2 Block diagram of the IMB-AO-22Ex-Hi/24VDC



X1: Connection to the backplane
X2: Connection to the output circuits via screw terminals

Figure: 32
Block diagram of the IMB-AO-22Ex-Hi/24VDC

6.4.3 Field connection

Terminal	Associated channel
1	Channel 1 +
2	Channel 1 –
3	Channel 2 +
4	Channel 2 –
5	Not used
6	Not used
7	Not used
8	Not used

Table: 27
Field connection of the MB-AO-22Ex-Hi/24VDC

6.4.4 Safety parameters

Associated equipment	ATEX approval	U_0 [V]	U_i [mA]	I_0 [mA]	I_i [mA]	P_0 [mW]	P_i [mW]	L_i* [µH]	C_i* [nF]	L_0* [mH]	C_0* [µF]
IMB-AO-22Ex-Hi/24VDC	TÜV 09 ATEX 555612	25	–	49	–	760	–	–	–	0,5/ 0,2	0,087/ 0,11

Table: 28
Safety parameters of the IMB-AO-22Ex-Hi/24VDC

* for explosion group IIC

6.4.5 Functional Safety – SIL values

Interface	SIL classification	SFF	DC_D	MTBF
IMB-AO-22Ex-Hi/24VDC	SIL3	92 %	0 %	164 years

Table: 29
SIL values of the IMB-AO-22Ex-Hi/24VDC

6.4.6 Application example

An actuator in the Ex area is assigned a setpoint value by means of a 4…20 mA signal. The actuator is fed via a phantom power supply from the IMB-AO…. The setpoint is set by the current (see Figure 33). The IMB-AO… can operate actuators with an internal resistance of up to 700 Ω.

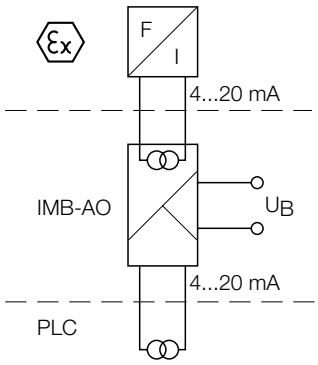


Figure: 33
Application example for IMB-AO-22Ex-Hi/24VDC

6.5 IMB-TI-RTD-231Ex-HCi/24VDC temperature measuring amplifier

The IMB-TI-RTD-231Ex-HCi/24VDC dual-channel temperature measuring amplifier evaluates temperature-related changes in Pt100 resistors to IEC 60751 and Ni100 resistors to DIN 43760 and outputs linear current signals as temperature values. It is also possible to evaluate Pt100 sensors to GOST, as well as CU50, CU53 CU100 and CuZn100 to GOST as well as resistors and potentiometers. Temperature resistors can be operated in two-wire, three-wire or four-wire circuits at the input circuit of the measuring amplifier.

NOTE

Deployment of a power supply other than Honeywell

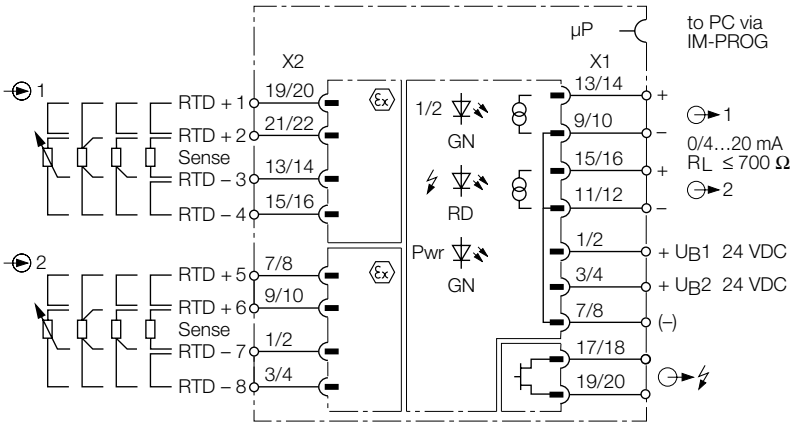
If you use a power supply other than Honeywell to feed the control system, an additional line bridge has to be deployed for proper operation of analog IMB-AI-22Ex-Hi/24VDC interface cards. For this purpose, bridge the minus connection (4–) at the front adapter IMB-FA-H-C300 to the minus connection of the IOTA-TB4.

6.5.1 LED indication

When lit, the green "Pwr" LED indicates operational readiness. The green "1" or "2" LEDs or the red "ϟ" LEDs assigned to a particular channel indicate the relevant status and faults (see chapter 6.5.3).

Figure: 34
IMB-TI-RTD-231Ex-HCi/24VDC temperature measuring amplifier

6.5.2 Block diagram of the IMB-TI-RTD-231Ex-HCi/24VDC



X1: Connection to the backplane
X2: Connection to the input circuits via screw terminals

Figure: 35
Block diagram of the IMB-TI-RTD-231Ex-HCi/24VDC

6.5.3 Status and fault indication via LEDs

State	LED-Code 1/2 GN	LED-Code RD	Parameter in DTM	Error current	Switching output active	Note
Hardware Error	2x		CurrentSourceError	■	■	
	3x		IdEx-Timeout/ ADC/ TemperatureIntern	■	■	
Software Error	4x		RomCrcError/ RamError	■	■	
	5x		CalibrationCrcError	■	■	
	6x		ParameterCrcError	■	■	
Simulation mode						
Channel off						
Line compensation activated					■	After line compensation, flashing returns to original status indication.
Current source wire break detection		2x			■	
Input error resistor		3x	Open	■	■	
		4x	OutOfRange	■	■	
		5x	OutOfCharacteristic	■	■	
Line compensation error		9x		■	■	only with RTD with 2-wire connection
Measuring span too small		11x		■	■	only for analog output
Measuring range outside of characteristic		12x				only for analog output
Normal mode						

Figure: 36
Status and fault indication on the IMB-TI-RTD-231Ex-HCi/24VDC

6.5.4 Parameterization and configuration

The parameterization and configuration of the device is carried out with the "Device Type Manager" (DTM) software tool on the PC (see also chapter 7, page 79). For this the temperature measuring amplifier is connected to the PC via the 3.5 mm "PC-Connect" jack socket on the front of the module. The prefabricated transmission cable is available from TURCK under the designation IM-PROG (Ident no. 6890422).
Alternatively the device can be configured via the current interface with the HART® protocol, for example using a multiplexer.

The following settings can be made with the DTM:

- Connection type (two, three or four-wire circuit)
- Lower measuring range
- Upper measuring range
- Input circuit monitoring for wire-break
- Current output behavior with faults in the input circuit: 0 or > 22 mA
- Output current (0/4...20 mA)
- Temperature unit (°C or °K)
- Mode (resistance, cable compensation)

The signals are transformed according to IEC 60751 for Pt100 and provided as linear temperature signals at the current output.

NOTE

Creating a project for the IMB-TI-RTD-231Ex-HCi/24VDC via the DTM
The popup window shown below (Figure 37) appears when the IMB-TI-RTD-231Ex-HCi/24VDC is selected for the project. This determines which channel is used for communication.
When using both channels, the same device must be added twice to the project tree.

Figure: 37
Popup window during project design with DTM

6.5.5 Field connection

Terminal	Associated channel
1	Channel 1, RTD +
2	Channel 1, RTD + Sense
3	Channel 1, RTD – Sense
4	Channel 1, RTD –
5	Channel 2, RTD +
6	Channel 2, RTD + Sense
7	Channel 2, RTD – Sense
8	Channel 2, RTD –

Table: 30
Field connection of the IMB-TI-RTD-231Ex-HCi/24VDC

6.5.6 Safety parameters

Associated equipment	ATEX approval	U_o [V]	U_i [mA]	I_o [mA]	I_i [mA]	P_o [mW]	P_i [mW]	L_i* [µH]	C_i* [nF]	L_o* [mH]	C_o* [µF]
IMB-TI-RTD-231Ex-HCi/24VDC	TÜV 10 ATEX 556047	5	–	5	–	6,2	–	73	–	100/ 10/ 1	1,8/ 2,4/ 3,4

Table: 31
Safety parameters of the IMB-TI-RTD-231Ex-Hi/24VDC

* for explosion group IIC

6.5.7 Functional Safety – SIL values

Interface	SIL classification	SFF	DC_D	MTBF
IMB-TI-RTD-231Ex-HCi/24VDC	SIL 2	91 %	91 %	110 years

Table: 32
SIL values of the IMB-TI-RTD-231Ex-HCi/24VDC

6.5.8 Function of the alarm monitor

The module is provided with both passive and active alarm functions. The alarm indication is not switched to "Good" until no other faults are present and all slots are occupied. The alarm output is switched off as soon as a wire break or short-circuit occurs in any cable to the temperature resistor. The alarm output is also switched off in the event of a power supply failure.
The alarm function can be disabled via the DTM.

6.5.9 Application example

A Pt100 sensor in a 4-wire circuit is to be run on the IMB-TI-RTD-231Ex-HCi/24VDC. For this Pt100 with its four cables is connected as shown in Figure 38. The appropriate jumpers must be set if a Pt100 is to be used in a two-wire or three-wire circuit.

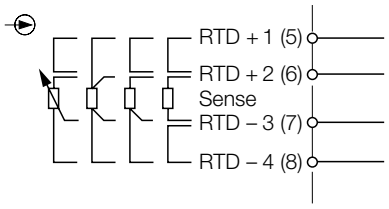


Figure: 38
Connection types for the Pt100 on IMB-TI-RTD-231Ex-HCi/24VDC

6.5.10 Accuracy of the resistance thermometers

TECHNICAL INFORMATION

Accuracy and connection type of Pt100 temperature resistors
The accuracy of a temperature measurement using a temperature resistor depends on several factors:

Selection of the Pt100
Pt100 sensors to IEC 60751 are available in four accuracy classes. These are classified by the letters AA, A, B and C. These tolerance ranges are further divided into subgroups as fractions (1/2, 1/3 etc.)

Connection type of the Pt100
The two-wire circuit is used in order to obtain a high signal density in a cable, but has the disadvantage that it has the least accuracy. This is because a change in the cable ambient temperature causes a change in the cable resistance. This change is fully included in the measurement as a fault.
The four-wire circuit provides the highest accuracy. The Pt100 is fed via two cables from a precision voltage source. The resistance measured value is measured using a high impedance voltage measuring circuit. This ensures that the value is not conditioned by cable resistance and ambient temperature.
The three-wire circuit is a compromise between measuring accuracy and cabling required.

Basic accuracy of the evaluation device.

The IMB-TI-RTD-231Ex-HCi/24VDC has the following accuracy:

Compensation error: ≤ 0.1 % of measuring voltage

Load impedance: ≤ 0.0005 % of full scale

Effect of load impedance: ≤ 0.0005 % of full scale

Temperature influence: ≤ 0.0005 %/K of full scale

Calculation example:

A class A Pt100 sensor in a 4-wire circuit is to be run on the IMB-TI-RTD-231Ex-HCi/24VDC.

With thermodynamic equilibrium this results in the following values for the class A Pt100 at 125 °C :

$dT = \pm (0.15\ °C + 0.002 \cdot T)$
$dT = \pm (0.15\ °C + 0.002 \cdot 125\ °C)$
$dT = \pm 0.4\ °C$

With a measuring range from 0…250 °C and an ambient temperature of 40 °C this produces the following values for the interface:

For compensation error: ±0.25 °CC

Effect of load impedance: ±0.0025 °C

Temperature influence: 0, as no change in ambient temperature

The total value:

Total error: Pt100 error + Device error = ±0.4 °C + (±00.255 °C) = ±0.6525 °C

This corresponds to: 0.0026 %.

6.5.11 Speed of temperature measuring

TECHNICAL INFORMATION

Estimating the speed of temperature measurement
The delay of the measuring sensor is a considerable factor particularly with temperature resistors.
A thermodynamic equilibrium must have been established to ensure correct measurement.

NOTE

Speed of temperature measurement for IMB-TI-RTD-231Ex-HCi/24VDC
The IMB-TI-RTD-231Ex-HCi/24VDC requires 1 s for a step response (measured value increases or drops abruptly between 10 % and 90 %).

6.6 IMB-TI-TC-231Ex-HCi/24VDC temperature measuring amplifier

The IMB-TI-TC-231Ex-HCi/24VDC dual-channel temperature measuring amplifier is designed to evaluate the temperature-dependent resistance changes of type B, E, J, K, L, N, R, S and T thermocouples in accordance with IEC 60584 and L, A1, A2, A3 and M thermocouples in accordance with GOST. Temperature resistances in two-wire and three-wire circuits, resistors, potentiometers and extra low voltages between -160...+160 mV can be evaluated and output as linear temperature current signals. The temperature resistance input can either be used as external cold junction compensation for the thermocouple or as a separate two-wire or three-wire measuring input.

NOTE

Deployment of a power supply other than Honeywell

If you use a power supply other than Honeywell to feed the control system, an additional line bridge has to be deployed for proper operation of analog IMB-AI-22Ex-Hi/24VDC interface cards. For this purpose, bridge the minus connection (4–) at the front adapter IMB-FA-H-C300 to the minus connection of the IOTA-TB4.

6.6.1 LED indication

When lit, the green "Pwr" LED indicates operational readiness. The green "1" or "2" LEDs or the red "⚡" LEDs assigned to a particular channel indicate the relevant status and faults (see chapter 6.6.3).

Figure: 39
IMB-TI-TC-231Ex-HCi/24VDC temperature measuring amplifier

6.6.2 Block diagram of the IMB-TI-TC-231Ex-HCi/24VDC

X1: Connection to the backplane
X2: Connection to the input circuits via screw terminals

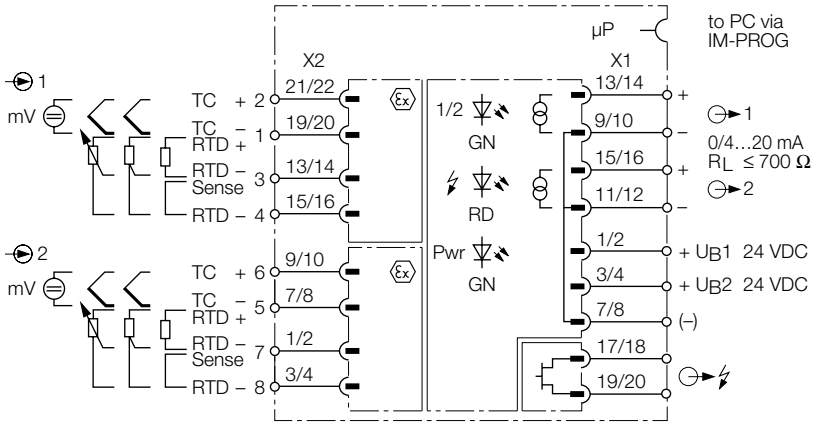


Figure: 40
Block diagram of the IMB-TI-TC-231Ex-HCi/24VDC

6.6.3 Status and fault indication via LEDs

State	LED-Code 1/2 GN / RD	Parameter in DTM	Error current	Switching output active	Note
Hardware Error	2x	CurrentSourceError	■	■	
	3x	IdEx-Timeout/ ADC/ TemperatureIntern	■	■	
Software Error	4x	RomCrcError/ RamError	■	■	
	5x	CalibrationCrcError	■	■	
	6x	ParameterCrcError	■	■	
Simulation mode					Mode for analog or digital output
Channel off			1 mA		Communication via HART®-current loop is maintained through current limitation.
Line compensation activated				■	After line compensation, flashing returns to original status indication.
Current source wire break detection	2x			■	
Input error resistor	3x	Open	■	■	
	4x	OutOfRange	■	■	
	5x	OutOfCharacteristic	■	■	
Input error low voltage	6x	Open	■	■	
	7x	OutOfRange	■	■	
	8x	OutOfCharacteristic	■	■	
Line compensation error	9x		■	■	only with RTD with 2-wire connection
Cold-junction temperature error (≠ -50...100° C)	10x		■	■	Mode for thermoelement
Measuring span too small	11x		■	■	only for analog output
Measuring range outside of characteristic	12x				only for analog output
Normal mode					

Figure: 41
Status and fault indication on the IMB-TI-TC-231Ex-HCi/24VDC

6.6.4 Parameterization and configuration

The parameterization and configuration of the device is carried out with the "Device Type Manager" (DTM) software tool on the PC (see also chapter 7, page 79). For this the temperature measuring amplifier is connected to the PC via the 3.5 mm "PC-Connect" jack socket on the front of the module. The prefabricated transmission cable is available from TURCK under the designation IM-PROG (Ident no. 6890422).
Alternatively the device can be configured via the current interface with the HART® protocol, for example using a multiplexer.
The following settings can be made with the DTM:

- Thermocouple type
- Lower measuring range
- Upper measuring range
- Input circuit monitoring for wire-break
- Current output behavior with faults in the input circuit: 0 or > 22 mA
- Internal or external cold junction compensation
- Output current (0/4...20 mA)
- Temperature unit (°C or °K)
- Mode (resistance, thermocouple, low voltage, cable compensation)

The signals are converted in compliance with the standard ITS 90/IEC 584 for thermocouples and IEC 60751 for Pt100 and provided at the current output as a function of temperature.

NOTE

Creating a project for the IMB-TI-TC-231Ex-HCi/24VDC via the DTM
The popup window shown below (Figure 42) appears when the IMB-TI-TC-231Ex-HCi/24VDC is selected for the project. This determines which channel is used for communication.
When using both channels, the same device must be added twice to the project tree.

Figure: 42
Popup window during project design with DTM

6.6.5 Field connection

Terminal	Associated channel
1	Channel 1, TC – /RTD +
2	Channel 1, TC +
3	Channel 1, RTD – Sense
4	Channel 1, RTD –
5	Channel 2, TC – /RTD +
6	Channel 2, TC +
7	Channel 2, RTD – Sense
8	Channel 2, RTD –

Table: 33
Field connection of the IMB-TI-TC-231Ex-HCi/24VDC

6.6.6 Safety parameters

Associated equipment	ATEX approval	U_o [V]	U_i [mA]	I_o [mA]	I_i [mA]	P_o [mW]	P_i [mW]	L_i* [µH]	C_i* [nF]	L_o* [mH]	C_o* [µF]
IMB-TI-TC-231Ex-HCi/24VDC	TÜV 10 ATEX 556047	5	–	5	–	6,2	–	73	–	100/ 10/ 1	1,8/ 2,4/ 3,4

Table: 34
Safety parameters of the IMB-TI-TC-231Ex-HCI/24VDC

* for explosion group IIC

6.6.7 Functional Safety – SIL values

Interface	SIL classification	SFF	DC_D	MTBF
IMB-TI-TC-231Ex- HCi/24VDC	SIL 2	91 %	91 %	110 years

Table: 35
SIL values of the IMB-TI-TC-231Ex-HCi/24VDC

6.6.8 Alarm monitor function

The module is provided with both passive and active alarm functions. The alarm indication is not switched to "Good" until no other faults are present and all slots are occupied. The alarm output is switched off as soon as a wire break or short-circuit occurs in any cable to the thermocouples or temperature resistors. The alarm output is also switched off in the event of a power supply failure.
The alarm function can be disabled via the DTM.

6.6.9 Application example

A Type J thermocouple is required to monitor an exothermic reaction in a reactor. The cold junction compensation (see chapter Cold junction compensation, 6.6.10) is to be achieved externally by a Pt100 in a three-wire circuit (see Figure 43).

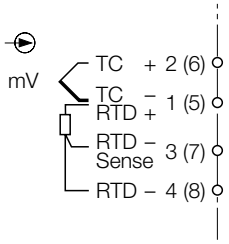


Figure: 43
Connection to IMB-TI-TC-231Ex-Hi/24VDC

6.6.10 Operating principle of thermocouples and cold junction compensation

TECHNICAL INFORMATION

Thermocouples

Thermocouples consist of two different metals that are welded together at one end. If the two ends are exposed to different temperatures, the thermocouples produce a thermoelectric voltage in the mV range (see Figure 42). As thermocouples are preferred for measuring high temperatures, this is called a hot and cold junction.

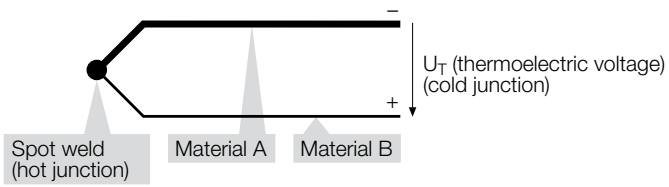


Figure: 44
Operating principle of a thermocouple

TECHNICAL INFORMATION

Cold junction compensation

Measurements using thermocouples are provided with cold junction compensation since the thermoelectric voltage only depends on the temperature difference.
Compensation can be implemented in three ways:
1. Internal compensation: This uses a temperature-sensitive resistor on the board of the IMB-TI-TC....
2. External compensation: For this a Pt100 is connected in a two-wire or three-wire circuit as close to the cold junction as possible (transition from thermocouple/compensation cable to copper cable).
3. Constant cold junction temperature: The cold junction is kept at the correct temperature in a terminal chamber.

NOTE

Additional cold junction compensation method for IMB-TI-TC-231Ex-HCi/24VDC

The cold junction temperature for the IMB-TI-TC-231-HCi/24VDC can also be entered permanently as a parameter via the DTM.

6.6.11 Connectable types of thermocouples

Thermocouple type	Colors	Standard	Materials	Measuring range
B	white – / gray +	IEC 60584	PtRh - PtRh	400…1750 °C
E	white – / violet +	IEC 60584	NiCr - CuNi	-100…1000°C
J	white – / black +	IEC60584	Fe - CuNi	-100…1200 °C
K	white – / green +	IEC60584	NiCr - Ni	-180…1372 °C
L	blue – / red +	DIN 43710	Fe - CuNi	-200…900 °C
N	white – / pink +	IEC60584	NiCrSi - NiSi	–
R	white – / orange +	IEC60584	PtRh - Pt	-50…1750 °C
S	white – / orange +	IEC60584	PtRh - Pt	-50…1750 °C
T	white – / brown +	IEC60584	Cu - Ni	-200…400 °C
L	–	GOST 8.585	NiCr-CuNi	-200…800 °C
A-1	–	GOST 8.585	95 %W5 %Re- 80 %W20 %Re	0…1750 °C
A-2	–	GOST 8.585	95 %W5 %Re- 80 %W20 %Re	0…1750 °C
A-3	–	GOST 8.585	95 %W5 %Re- 80 %W20 %Re	0…1750 °C
M	–	GOST 8.585	Cu-CuNi	-200…100 °C

Table: 36
Thermocouples

6.6.12 Speed of thermocouples

TECHNICAL INFORMATION

Thermocouples
One of the most outstanding features of thermocouples is their fast adaption to temperature changes. For this reason, the thermal equilibrium is achieved faster with a thermocouple than with a temperature resistor.

NOTE

Conversion speed of thermocouples with IMB-TI-TC-231Ex-HCi/24VDC
The conversion speed of the IMB-TI-TC-231-HCi/24VDC is 1 s.
Please contact your TURCK sales office if a faster speed is required.

6.7 IMB-DO-44Ex-N/24VDC and IMB-DO-44Ex-P/24VDC valve control modules

The IMB-DO-44Ex.../24VDC valve control modules provide an intrinsically safe output voltage with a limited voltage and current. This enables them to be used for supplying loads in the Ex area. Connected loads that comply with the relevant requirements can be operated in hazardous gas and dust areas. Typical applications include the actuation of Ex i pilot valves, the supply of indicators and transmitters.
The IMB-DO-44Ex-N/24VDC valve control module is provided with negative logic inputs, whilst the IMB-DO-44Ex-P/24VDC is provided with positive logic inputs.
The output values are tuned to the valves of various manufacturers (see chapter 6.7.7).
The module is provided with a passive alarm function. The alarm indication is thus not switched to "Good" until all slots are occupied.

NOTE

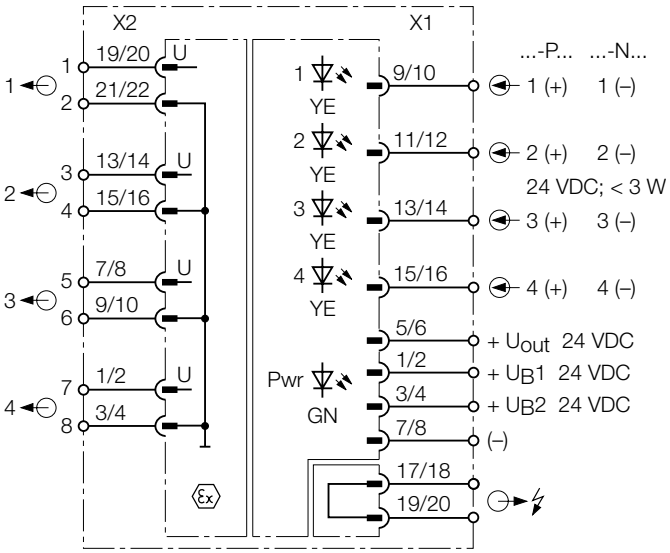
Use with the Honeywell C300
The positive logic version IMB-DO-44Ex-P/24VDC must be used for the Honeywell C300.

6.7.1 LED indication

When lit, the green "Pwr" LED indicates operational readiness. The switching state of the outputs is indicated by the appropriate yellow LED "1...4" assigned to each of the corresponding channels, so that the corresponding LED is lit if the assigned channel is switched.

Figure: 45
IMB-DO-44Ex..../24VD valve control module

6.7.2 Block diagram of the IMB-DO-44Ex-N/24VDC/IMB-DO-44Ex-P/24VDC



X1: Connection to the backplane
X2: Connection to the output circuits via screw terminals

Figure: 46
Block diagram of the IMB-DO-44Ex-.../24VDC

6.7.3 Field connection

Terminal	Associated channel
1	Channel 1+
2	Channel 1 –
3	Channel 2+
4	Channel 2 –
5	Channel 3+
6	Channel 3 –
7	Channel 4+
8	Channel 4 –

Table: 37
Field connection of the IMB-DO-44Ex.../24VDC

6.7.4 Safety parameters

Associated equipment	ATEX approval	U_o [V]	U_i [mA]	I_o [mA]	I_i [mA]	P_o [mW]	P_i [mW]	L_i* [µH]	C_i* [nF]	L_o* [mH]	C_o* [µF]
IMB-DO-44Ex.../24VDC	TÜV 09 ATEX 555410	21,2	–	75,3	–	898	–	–	–	12	0,62

Table: 38
Safety parameters of the IMB-DO-44Ex-../24VDC

* for explosion group IIB

6.7.5 Functional Safety – SIL values

Interface	SIL classification	SFF	DC_D	MTBF
IMB-DO-44Ex.../24VDC	SIL3	97 %	0 %	192 years

Table: 39
SIL values of the IMB-DO-44Ex-.../24VDC

6.7.6 Application example

A pilot valve for controlling a rotary actuator is to be implemented with intrinsic safety.
The valve requires a minimum voltage of 8.2 V and a minimum current of 28 mA.
The IMB-DO… can supply all the values below the envelope curve (see Figure 47).
The pilot valve can therefore be operated by the IMB-DO....

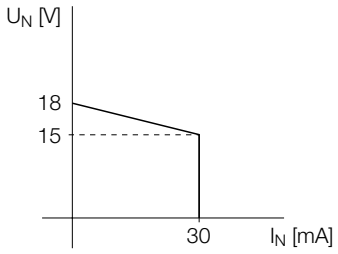


Figure: 47
Output characteristic curve of the IMB-DO-44Ex-.../24VDC

6.7.7 Valve compatibility list

Manufacturer	Valve type	U_{min} [V]	I_{min} [mA]	U_i [V]	I_i [mA]	P_i [mW]
Bürkert	0590	10,4	29,0	35,0	900	900
Bürkert	5470	10,4	29,0	35,0	900	1100
Bürkert	6014	10,8	29,0	35,0	900	1100
Bürkert	6104	10,8	29,0	35,0	900	1000
Bürkert	6106	10,8	29,0	35,0	900	900
Bürkert	6516	10,8	29,0	35,0	900	900
Bürkert	6517	10,8	29,0	35,0	900	900
Bürkert	6518	10,4	29,0	35,0	900	1100
Bürkert	6519	10,4	29,0	35,0	900	1100
Bürkert	8631	11,7	23,0	35,0	900	1000
Bürkert	8640	11,7	23,0	35,0	900	900
Hörbiger	S9PM61	7	2	30	–	–
Hörbiger	S9PN65	11	2	30	–	–
Hörbiger	S29PM61	7	2	30	–	–
Hörbiger	S29PN65	11	2	30	–	–
Hörbiger	P8PM64	6,0	1,7	16	–	–
Hörbiger	P8PM61	7	2	30	–	–
Hörbiger	P8PN65	11	2	30	–	–
Hörbiger	P20PM61	7	2	30	–	–
Samsomatic	3701-X1	4,8	1,41	25	150	–
Samsomatic	3701-X2	9,6	1,52	27	125	–
Samsomatic	3701-X3	18	1,57	28	115	–
Samsomatic	3963-11	4,8	1,41	25	150	–
Samsomatic	3963-12	9,6	1,52	27	125	–
Samsomatic	3963-13	18	1,57	28	115	–
Samsomatic	3964-X1	4,8	1,41	25	150	–
Samsomatic	3964-X2	9,6	1,52	27	125	–
Samsomatic	3964-X3	18	1,57	28	115	–
Samsomatic	3965-X1	4,8	1,41	25	150	–
Samsomatic	3965-X2	9,6	1,52	27	125	–
Samsomatic	3965-X3	18	1,57	28	115	–
Samsomatic	3967-X1	4,8	1,41	25	150	–
Samsomatic	3967-X2	9,6	1,52	27	125	–
Samsomatic	3967-X3	18	1,57	28	115	–

Manufacturer	Valve type	U_{min} [V]	I_{min} [mA]	U_i [V]	I_i [mA]	P_i [mW]
Norgren Herion	2033	9	30	–	–	–
Norgren Herion	2034	10	27	–	–	–
Norgren Herion	2035	11,5	25	–	–	–
Norgren Herion	2036	13	23	–	–	–
Norgren Herion	2037	14,4	21	–	–	–
Norgren Herion	2038	15,9	19	–	–	–
Norgren Herion	2080	5	1	–	–	–
Norgren Herion	2081	10	2,7	–	–	–
Norgren Herion	2082	5	1	–	–	–
Norgren Herion	2083	10	2,7	–	–	–
Norgren Herion	2084	4	1,6	–	–	–
Telektron	V525011L00	12	8	–	–	–
Eugen Seitz	121.11.01	13	16	–	–	–
Eugen Seitz	121.11.02	15	12	–	–	–
Eugen Seitz	121.11.03	14	16	–	–	–
ASCO Joucomatic	630 00 061 6V	6	6	30	200	900
ASCO Joucomatic	631 00 061 8V	7,2	10	30	200	900
ASCO Joucomatic	631 00 061 12V	10,8	6,8	30	200	900
ASCO Joucomatic	632 00 061 12V	10,8	8,1	30	200	900
ASCO Joucomatic	630 00 091 6V	6	6	30	200	900
ASCO Joucomatic	631 00 091 8V	7,2	10	30	200	900
ASCO Joucomatic	632 00 091 12V	10,8	6,8	30	200	900
ASCO Joucomatic	633 00 091 12V	10,8	8,1	30	200	900
ASCO Joucomatic	630 00 051 6V	6	6	30	200	900
ASCO Joucomatic	630 00 051 8V	7,2	10	30	200	900
ASCO Joucomatic	630 00 051 12V	10,8	6,8	30	200	900
ASCO Joucomatic	630 00 051 12V	10,8	8,1	30	200	900
Parker Lucifer	482160	10,7	29	–	–	–
Parker Lucifer	482170	10,7	29	–	–	–
Parker Lucifer	492965	13	20	–	–	–

Table: 40

Valve compatibility list

6.8 IMB-BM dummy module

The IMB-BM dummy module must be fitted if not all slots are assigned with function modules. This fulfills the requirements of degree of protection IP20.
The dummy module is provided with a passive alarm. The alarm indication is thus not switched to "Good" until all slots are occupied.

NOTE

Activation of an alarm due to empty slots not being filled with IMB-BM dummy module
The alarm is activated if the empty slots are not filled with the IMB-BM dummy module.

6.8.1 LED indication

The green "Pwr" LED indicates operational readiness.

Figure: 48
IMB-BM dummy module

6.8.2 Block diagram of the IMB-BM

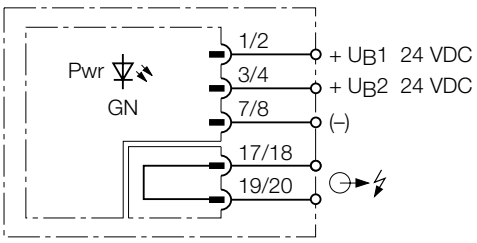


Figure: 49
Block diagram of the IMB-BM

7 Parameterization via PACTware™ and DTM

TECHNICAL INFORMATION

PACTware™ and DTM
PACTware™ stands for "Process Automation Configuration Tool" and is an open configuration software in which any manufacturer can integrate the operation of their field devices. The key priority of the PACTware™ concept is optimum device operation.
Unlike the approach of describing devices with text files (DD = Device Description), PACTware™ uses a standard interface (FDT = Field Device Tool) between the PACTware™ frame software and the individual software modules (DTM = Device Type Manager) in order to operate the devices. It enables a particularly flexible and user-friendly operating concept to be implemented.
FDT offers a standard interface in order to use the software modules for the field devices of different manufacturers in various applications.

The required DTMs are available both as a basic version (with limited functionality) and as a Professional version (with enhanced functions). The PACTware™ frame applications and the basic DTMs can be downloaded free of charge from www.turck.de.

The Professional version with special functions can be activated using the license code subject to a charge.

The following special functions are provided:

- Monitor function: The current measured value and the states of the inputs and outputs can be displayed in a monitor window. The cyclical refreshing can be deactivated.
- Print function: The parameters can be printed out in three different categories:
  Offline parameterization (all parameters)
  Measured value (frequency/speed, output current, measuring range of the output current in %, output voltage, measuring range of the output voltage in %)
  Diagnostics (all diagnostic bits)
- Trend viewer: A selection of measured values can be plotted cyclically. This enables value changes to be viewed online. Plotted value curves can be stored in a specially formatted text file.
- Memory function: This function is used to store all parameters.
- Storage in a ring memory: Enables the storing of measured values internally in the device

7.1 Software installation of PACTware™ and device DTMs

To install PACTware™ and the device DTMs on your computer you will need the following software components:

- PACTware™ software for the parameterization of interface modules and excom®, as well as DPC system via FDT/DTM
- DTM

PACTware™ software and DTM can be downloaded free of charge via the Internet from www.turck.com.

➤ Visit the Turck website at www.turck.com ➔ www.turck.de ➔ Download.

◐ Your computer will ask for a directory in which the files are to be stored on the hard disk. The files are self-extracting file archives, so-called Zip files that extract themselves automatically when called.

➤ Double-click the file to unzip the ZIP archives.

➤ The unzipping of the file is started by clicking on Extract.

◐ The directory "TURCK_FILES" is created on the current drive (e.g. C:\).

➤ Extract both file archives: (PACTware™ and DTM), before starting with the actual installation of the software.

7.1.1 Installing PACTware™

Start first with the installation of PACTware™ on your computer.

➤ Launch Windows Explorer and open the directory "TURCK_FILES\PACTware...Setup...\PACTware".

➤ Start the "setup.exe" file located in this directory.

➤ Follow the self-explanatory onscreen instructions provided by the installation program and complete the installation.

7.1.2 Installing the HART® communication driver

Once the PACTware™ has been successfully installed, the HART® communication driver is installed next.

➤ Start the "setup.exe" file in the directory "TURCK_FILES\...\Dtms\Hart\".

➤ Follow the self-explanatory onscreen instructions provided by the installation program and complete the installation.

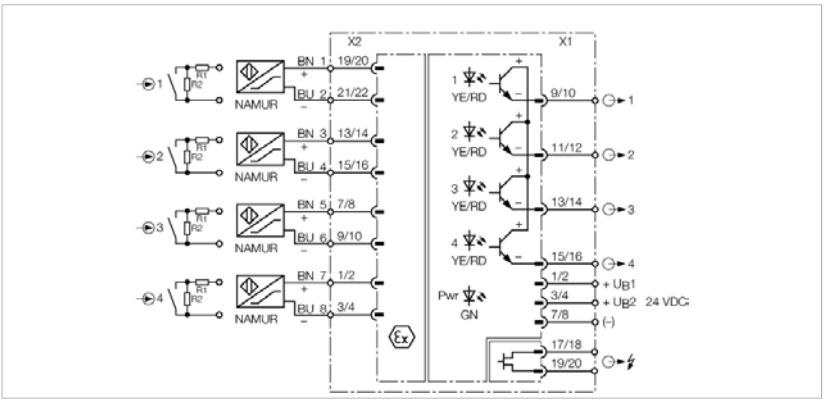
7.1.3 Installing the device DTM

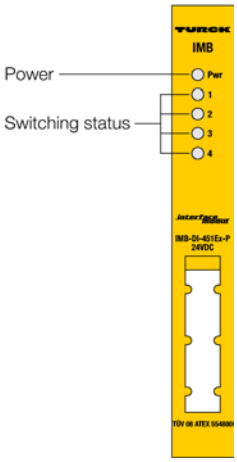
➤ After the HART® communication driver has been successfully installed, you still have to install the DTM for the specific device.

◐ A directory has been created for every DTM you have downloaded. The name of the directory starts with the first 4 or 5 letters of the device type you selected.

8 Appendix: Data sheets

Isolating switching amplifier
4-channel
IMB-DI-451Ex-P/24VDC





The four-channel isolating switching amplifier IMB-DI-451Ex-P/24VDC is equipped with intrinsically safe input circuits.

Sensors according to EN 60947-5-6 (NAMUR) or potential-free contactors can be connected to the device.

Each output circuit features one short circuit proof PNP transistor and additionally a common alarm output. When using mechanical contacts, resistors (II) or resistor modules WM 1 must be wired to the contacts (see circuit diagram).

The green LED indicates operational readiness. The output switching status is indicated yellow by the two color LED. In the event of input circuit errors the dual color LED changes to red. As a result, the output and the alarm transistor are inhibited.

The module features a passive alarm. The alarm message is cleared as soon as all slots are assigned.

- **Isolating switching amplifier for transmission of intrinsically safe, binary signals**
- **Intrinsically safe input circuits Ex ia**
- **Application area acc. to ATEX: II (1) G, II (1) D**
- **SIL 2**
- **Monitoring of input circuits for wire-break/short-circuit**
- **Four transistor outputs, PNP, short-circuit proof**
- **Common alarm output**
- **Galvanic isolation between input circuits and output circuits**

interface modul

Isolating switching amplifier
4-channel
IMB-DI-451Ex-P/24VDC

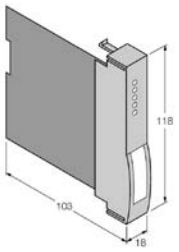
TURCK Industrial Automation

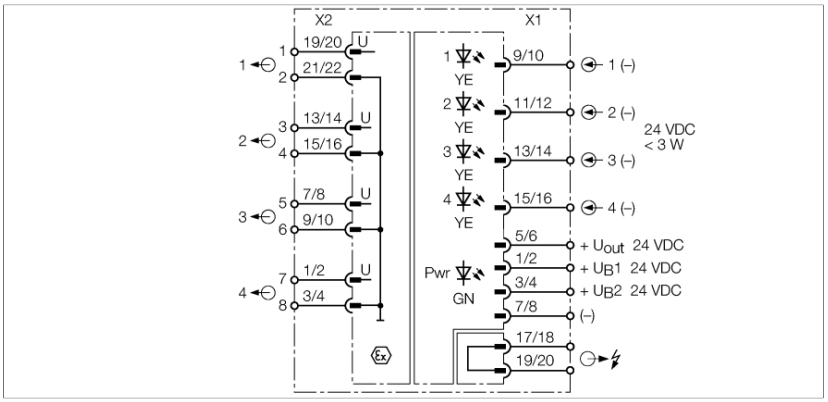
Type	IMB-DI-451Ex-P/24VDC
Ident-No.	7570002
Nominal voltage	24 VDC
Operational voltage range	20…30 VDC
Power consumption	≤ 2 W
Power loss, typical	≤ 1.55 W
NAMUR	EN-60947-5-6
No-load voltage	8.2 VDC
Short-circuit current	8.2 mA
Input resistance	1 kΩ
Cable resistance	≤ 50 Ω
Switch-on threshold:	1.55 mA
Switch-off threshold:	1.75 mA
Wire breakage threshold	≤ 0.1 mA
Short-circuit threshold	≥ 6 mA
Semicondutor output circuit(s)	
Output circuits (digital)	4 x transistors (pnp, short-circuit proof)
Switching voltage	≤ 20 V +/- 2%
Switching current per output	≤ 3 mA
Switching frequency	≤ 2000 Hz
Galvanic isolation	
Test voltage	2.5 kV
Ex approval acc. to conformity certificate	TÜV 08 ATEX 554880
Application area	II (1) G, II (1) D
Protection type	[Ex ia Ga] IIC; [Ex ia Da] IIIC
Max.output voltage U_o	≤ 12 V
Max. output current I_o	≤ 12.4 mA
Max. output power P_o	≤ 37.2 mW
Rated voltage	250 V
Characteristic	linear
External inductance/capacitance L_i/C_i	Li = 76,5 µH, Ci = negligibly small
External inductance/capacitance L_o/C_o	

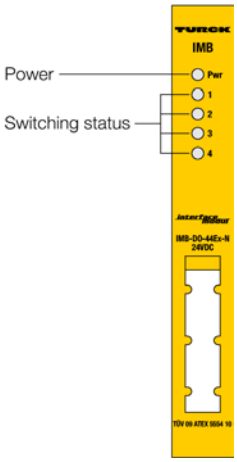
Ex ia	IIC		IIB	
Lo [mH]	10	0.92	20	1.92
Co [µF]	0.49	0.78	2.2	3.6

Approval	SIL 2
Indication	
Operational readiness	green
Switching state	yellow
Error indication	red
Protection class	IP20
Ambient temperature	-25…+70 °C
Dimensions	118 x 18 x 103 mm
Weight	130 g
Mounting instruction	Mounting and operation only in conjunction with the IMB backplane
Housing material	Polycarbonate/ABS

Dimensions







The 4-channel valve control module IMB-DO-44EX-N/24VDC is current and voltage limited and provides intrinsically safe output voltage. Thus loads can be triggered directly in the Ex-area. The device can be operated with NPN DCS/PLC-DO cards.

Within the area of applicability of the European directive 94/9/EG (ATEX) it is permitted to operate connected loads in potentially explosive atmospheres caused by dust or gas, provided they comply with the applicable regulations.

Typical applications are the control of Ex i pilot valves as well as the supply of displays and transmitters.

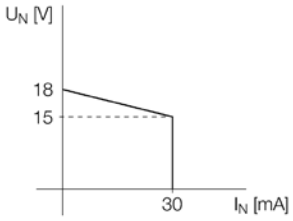
The switching status of the output is indicated by a yellow LED.

The module features a passive alarm. The alarm message is cleared as soon as all slots are assigned. The green LED indicates operational readiness.

- **Valve control module for the supply of intrinsically safe, passive two-terminal networks**
- **Intrinsically safe output circuits Ex ia**
- **Application area acc. to ATEX: II (1) G, II (1) D**
- **SIL 3**
- **4-channel valve control module**
- **Alarm output**
- **Switching frequency ≤ 500Hz**
- **LED switch state indication**
- **Galvanic isolation between input circuits and output circuits**

valve control modules
4-channel
IMB-DO-44Ex-N/24VDC

Type	IMB-DO-44Ex-N/24VDC
Ident-No.	7570003
Nominal voltage	24 VDC
Operational voltage range	20…30 VDC
Power consumption	≤ 4.5 W
Power loss, typical	≤ 2.26 W
0-signal	0…5 VDC
1-signal	20...30 VDC
Current input	45 mA
Output current	30 mA
Output voltage	U=18 V

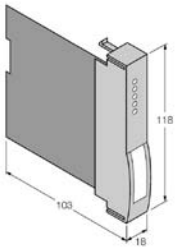


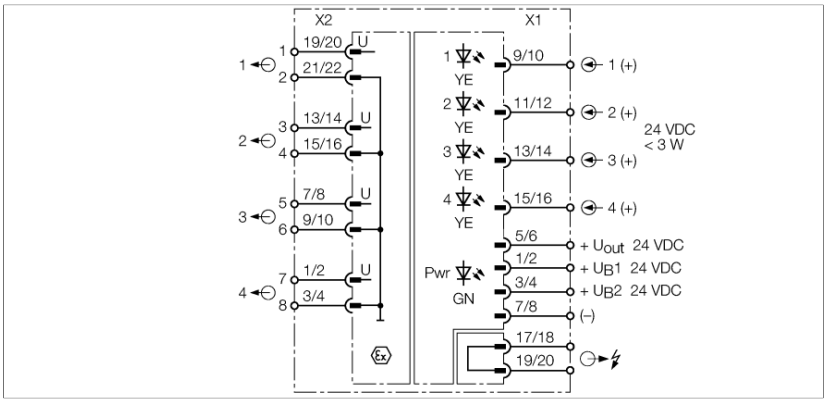
Limit frequency	≤ 500 Hz
Galvanic isolation	
Test voltage	2.5 kV
Ex approval acc. to conformity certificate	TÜV 09 ATEX 555410
Application area	II (1) G, II (1) D
Protection type	[Ex ia Ga] IIB; [Ex ia Da] IIIC
Max.output voltage U_o	≤ 21.1 V
Max. output current I_o	≤ 75.3 mA
Max. output power P_o	≤ 898 mW
Rated voltage	250 V
Characteristic	angular
External inductance/capacitance L_i/C_i	negligibly small
External inductance/capacitance L_o/C_o	

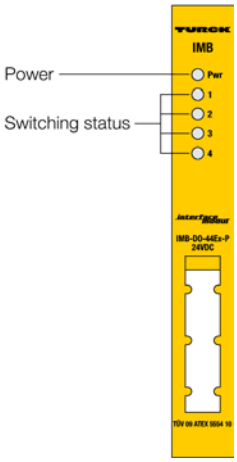
Ex ia	II B
Lo [mH]	12
Co [nF]	620

Approval	SIL 3
Indication	
Operational readiness	green
Switching state	yellow
Protection class	IP20
Ambient temperature	-25…+70 °C
Dimensions	118 x 18 x 103 mm
Weight	131 g
Mounting instruction	Mounting and operation only in conjunction with the IMB backplane
Housing material	Polycarbonate/ABS

Dimensions







The 4-channel valve control module IMB-DO-44Ex-P/24VDC provides current and voltage limited, intrinsically safe output voltage. Thus loads can be triggered directly in the Ex-area.

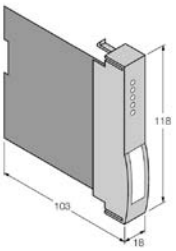
The device can be operated with PNP DCS/PLC-DO cards. Within the area of applicability of the European directive 94/9/EG (ATEX) it is permitted to operate connected loads in potentially explosive atmospheres caused by dust or gas, provided they comply with the applicable regulations.

Typical applications are the control of Ex i pilot valves as well as the supply of displays and transmitters.

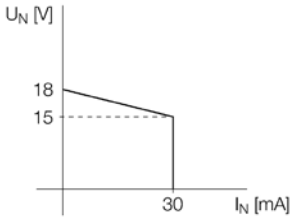
The switching status of the related output is indicated by a yellow LED. The module features a passive alarm. The alarm message is cleared as soon as all slots are assigned. The green LED indicates operational readiness.

- **Valve control module for the supply of intrinsically safe, passive two-terminal networks**
- **Intrinsically safe output circuits Ex ia**
- **Application area acc. to ATEX: II (1) G, II (1) D**
- **SIL 3**
- **4-channel valve control module**
- **Alarm output**
- **Switching frequency ≤ 500Hz**
- **LED status indication**
- **Galvanic isolation of input circuits and output circuits**

valve control modules
4-channel
IMB-DO-44Ex-P/24VDC



Type	IMB-DO-44Ex-P/24VDC
Ident-No.	7570018
Nominal voltage	24 VDC
Operational voltage range	20…30 VDC
Power consumption	≤ 4.5 W
Power loss, typical	≤ 2.26 W
0-signal	0…5 VDC
1-signal	20...30 VDC
Current input	45 mA
Output current	30 mA
Output voltage	U=18 V

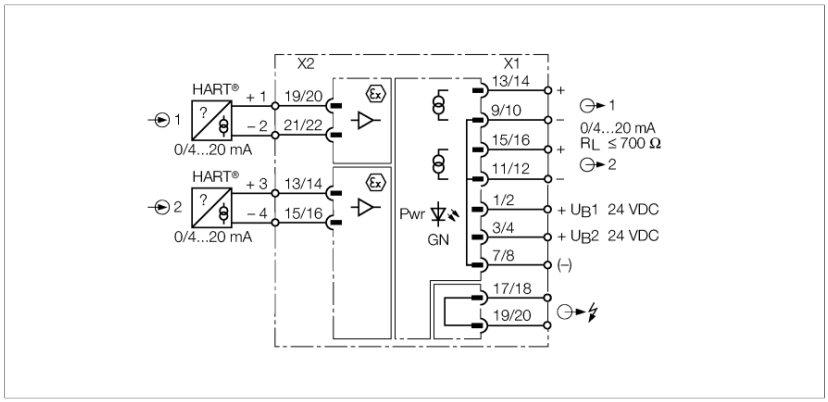


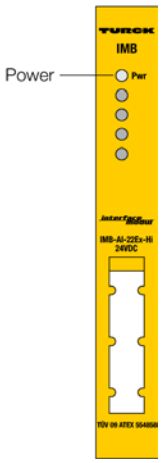
Limit frequency	≤ 500 Hz
Galvanic isolation	
Test voltage	2.5 kV
Ex approval acc. to conformity certificate	TÜV 09 ATEX 555410
Application area	II (1) G, II (1) D
Protection type	[Ex ia Ga] IIB; [Ex ia Da] IIIC
Max.output voltage U_o	≤ 21.1 V
Max. output current I_o	≤ 75.3 mA
Max. output power P_o	≤ 898 mW
Rated voltage	250 V
Characteristic	angular
External inductance/capacitance L_i/C_i	negligibly small
External inductance/capacitance L_o/C_o	

Ex ia	II B
Lo [mH]	12
Co [nF]	620

Approval	SIL 3
Indication	
Operational readiness	green
Switching state	yellow
Protection class	IP20
Ambient temperature	-25…+70 °C
Dimensions	118 x 18 x 103 mm
Weight	0 g
Mounting instruction	Mounting and operation only in conjunction with the IMB backplane
Housing material	Polycarbonate/ABS

analogue signal transmitters
dual-channel
IMB-AI-22Ex-Hi/24VDC





Standard active current signals are galvanically isolated and transmitted via the dual-channel analog signal isolator IMB-AI-22EX-HI/24VDC from the Ex area to the safe area.

The device features one input circuit 0… 20 mA and one short-circuit proof output circuit 0…20 mA. Input circuit, output circuit and supply voltage are each galvanically isolated.

The input signals are transmitted without attenuation to the outputs in the safe area.

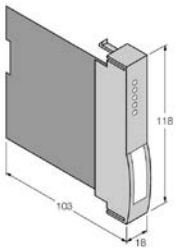
The module features a passive alarm. The alarm message is cleared as soon as all slots are assigned. The green LED indicates operational readiness.

- **Isolating switching amplifiers for the transmission of active, intrinsically safe input signals**
- **Intrinsically safe input circuits Ex ia**
- **Application area acc. to ATEX: II (1) G, II (1) D**
- **SIL 3**
- **Dual-channel analog signal isolator**
- **HART® transparent**
- **Galvanic isolation between input circuits and output circuits**
- **Galvanic isolation of the channels on the non-intrinsically safe end**

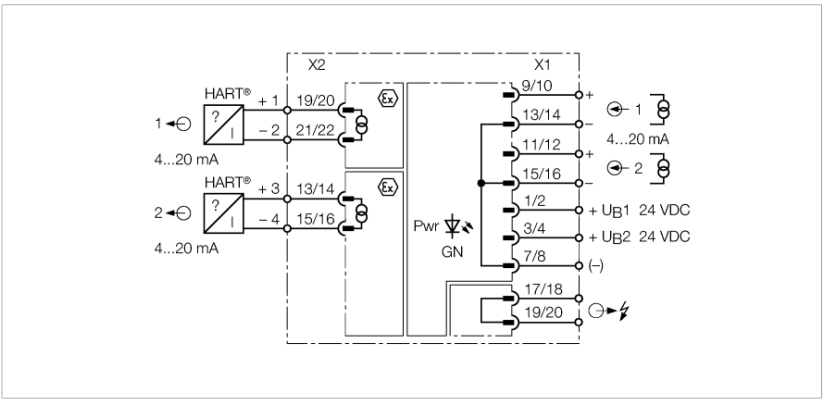
analogue signal transmitters
dual-channel
IMB-AI-22Ex-Hi/24VDC

Type	IMB-AI-22Ex-Hi/24VDC
Ident-No.	7570004
Nominal voltage	24 VDC
Operational voltage range	20…30 VDC
Power consumption	≤ 1.2 W
Power loss, typical	≤ 0.88 W
Current input	0-20 mA
Control circuits	Current limiting 42 mA
Output current	0...20 mA
Load resistance current output	≤ 0.7 kΩ
Rise time (10-90%)	≤ 10 ms
Dropout time (90…10%)	≤ 10 ms
Measuring accuracy	≤ 0.1 % of full scale
Temperature drift	≤ 0.001 % / K
Galvanic isolation	
Test voltage	2.5 kV
Ex approval acc. to conformity certificate	TÜV 09 ATEX 554858
Application area	II (1) G, II (1) D
Protection type	[Ex ia Ga] IIC; [Ex ia Da] IIIC
Rated voltage	250 V
Max. input voltage U_i	≤ 27 V
Max. input current I_i	≤ 150 mA
Max. input power P_i	≤ 1000 mW
External inductance/capacitance L_i/C_i	negligibly small
Approval	SIL 3
Indication	
Operational readiness	green
Protection class	IP20
Ambient temperature	-25…+70 °C
Dimensions	118 x 18 x 103 mm
Weight	160 g
Mounting instruction	Mounting and operation only in conjunction with the IMB backplane
Housing material	Polycarbonate/ABS

Dimensions



Analog signal isolator dual-channel IMB-AO-22Ex-Hi/24VDC



The standard current signal is galvanically isolated and transmitted via the dual-channel HART® output isolator IMB-AO-22Ex-Hi/24VDC from the safe to the Ex-area 1:1 without attenuation.

Bidirectional transmission of analog and digital HART® communication signals.

Typical applications are for example, the control of I/P converters (at control valves for example) or indicators in the Ex-area.

The module features input circuit monitoring. In the event of wire-break or short-circuit in the field circuit, the input current drops to < 1.2mA.

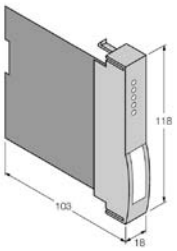
The module features a passive alarm. The alarm message is cleared as soon as all slots are assigned. The green LED indicates operational readiness.

- **Analog signal isolator for transmission of intrinsically safe output signals**
- **Intrinsically safe output circuits Ex ia**
- **Application area acc. to ATEX: II (1) G, II (1) D**
- **SIL3**
- **Dual-channel analog signal isolator**
- **Galvanic isolation of input circuits and output circuits**
- **Galvanic isolation of the channels on the non-intrinsically safe end**
- **HART® transparent**

interface modul

Analog signal isolator dual-channel IMB-AO-22Ex-Hi/24VDC

TURCK Industrial Automation

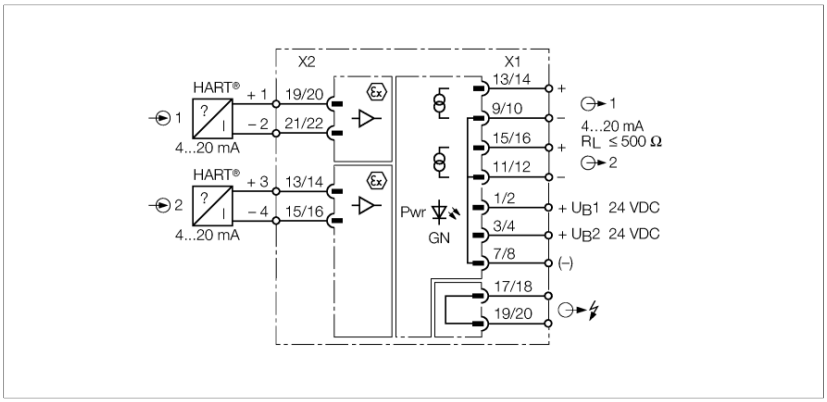


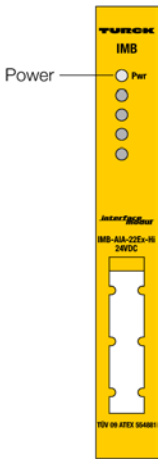
Type	IMB-AO-22Ex-Hi/24VDC
Ident-No.	7570005
Nominal voltage	24 VDC
Operational voltage range	20…30 VDC
Power consumption	≤ 2.2 W
Power loss, typical	≤ 1.4 W
Current input	4…20 mA
Control circuits	Current limiting 42 mA
Output current	4...20 mA
Load resistance current output	≤ 0.7 kΩ
Minimum load	≥ 40 Ω
Rise time (10-90%)	≤ 10 ms
Dropout time (90…10%)	≤ 10 ms
Measuring accuracy	≤ 0.1 % of full scale
Temperature drift	≤ 0.002 % / K
Galvanic isolation	
Test voltage	2.5 kV
Ex approval acc. to conformity certificate	TÜV 09 ATEX 555612
Application area	II (1) G, II (1) D
Protection type	[Ex ia Ga] IIC; [Ex ia Da] IIIC
Max.output voltage U_o	≤ 25 V
Max. output current I_o	≤ 49 mA
Max. output power P_o	≤ 760 mW
Rated voltage	250 V
Characteristic	angular
External inductance/capacitance L_i/C_i	negligibly small
External inductance/capacitance L_o/C_o	

Ex ia	IIC		IIB	
Lo [mH]	0.5	0.2	21	0.2
Co [µF]	0.087	0.11	0.36	0.67

Approval	SIL 3
Indication	
Operational readiness	green
Protection class	IP20
Ambient temperature	-25…+70 °C
Dimensions	118 x 18 x 103 mm
Weight	183 g
Mounting instruction	Mounting and operation only in conjunction with the IMB backplane
Housing material	Polycarbonate/ABS

Isolating transducers
dual-channel
IMB-AIA-22Ex-Hi/24VDC





The dual-channel HART® isolating transducer IMB-AiA- 22Ex-Hi/24VDC is used to operate intrinsically safe 2-wire HART® transducers in the Ex area and to transmit the measured signal to the safe area.

In addition to the analog signals, digital HART® communication signals can be transferred bidirectionally.

The device features one input and one output circuit, with 0/4…20 mA each. Input circuit, output circuit and supply voltage are each galvanically isolated.

The input signal is transmitted 1:1 without attenuation to the output in the safe area.

Due to the 1:1 transmission characteristic, wire-break is provided with 3.6 mA and short-circuit with 21 mA.

The module features a passive alarm. The alarm message is cleared as soon as all slots are assigned. The green LED indicates operational readiness.

- **Power supply of transmitters in the Ex area and transmission of intrinsically safe signals**
- **Intrinsically safe input circuits Ex ia**
- **Application area acc. to ATEX: II (1) G, II (1) D**
- **SIL 2**
- **2-channel isolating transducer**
- **HART® transparent**
- **Alarm output**
- **Galvanic isolation of input circuits and output circuits**
- **Galvanically isolated channels in the Ex area**

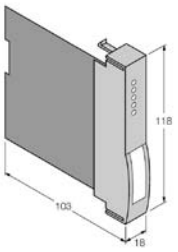
Isolating transducers
dual-channel
IMB-AIA-22Ex-Hi/24VDC

Type	IMB-AIA-22Ex-Hi/24VDC
Ident-No.	7570006
Nominal voltage	24 VDC
Operational voltage range	20…30 VDC
Power consumption	≤ 2.1 W
Power loss, typical	≤ 1.04 W
Input circuits	Isolating transducer
Short-circuit current	35 mA
Transmitter connection	
Supply voltage	≥13 V
Current	0...22 mA
Current input	4…20 mA
Output current	4...20 mA
Load resistance current output	≤ 0.5 kΩ
Wire break monitoring	≤ 3.6 mA
Short circuit monitoring	≥ 21 mA
Limit frequency	≤ 30 Hz
Rise time (10-90%)	≤ 10 ms
Dropout time (90…10%)	≤ 10 ms
Measuring accuracy	≤ 0.1 % of full scale
Temperature drift	≤ 0.005 % / K
Galvanic isolation	
Test voltage	2.5 kV
Ex approval acc. to conformity certificate	TÜV 09 ATEX 554881
Application area	II (1) G, II (1) D
Protection type	[Ex ia Ga] IIB/IIC ; [Ex ia Da] IIIC
Max.output voltage U_o	≤ 23 V
Max. output current I_o	≤ 64.5 mA
Max. output power P_o	≤ 799 mW
Rated voltage	250 V
Characteristic	Trapezoidal
External inductance/capacitance L_i/C_i	Li = 76,5 µH, Ci = 22 nF
External inductance/capacitance L_o/C_o	

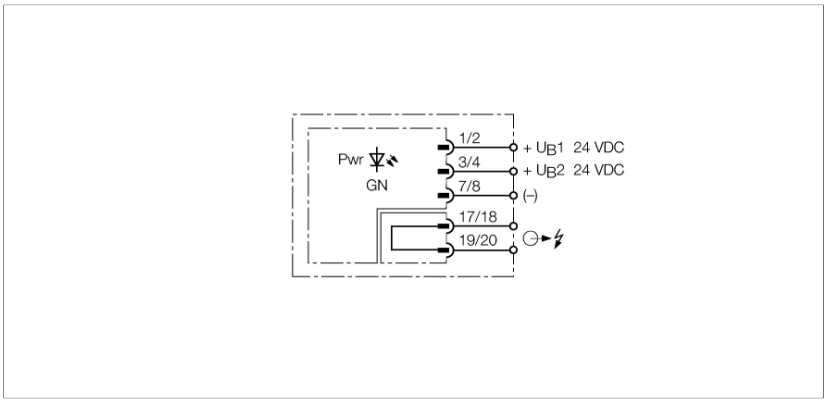
Ex ia	IIB			IIC		
Lo[mH]	4.8	0.9	0.12	0.804	0.424	0.024
Co[nF]	358	418	718	46	62	121

Approval	SIL 2
Indication	
Operational readiness	green
Protection class	IP20
Ambient temperature	-25…+70 °C
Dimensions	118 x 18 x 103 mm
Weight	154 g
Mounting instruction	Mounting and operation only in conjunction with the IMB backplane
Housing material	Polycarbonate/ABS

Dimensions



Dummy module
IMB-BM



The dummy module has to be plugged in case not all card slots are assigned. This way protection class IP20 is fulfilled.

The module features a passive alarm. The alarm message is cleared as soon as all slots are assigned.

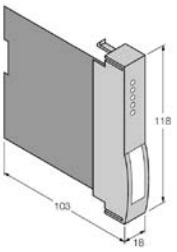
The dummy module features a PWR-LED to monitor the power supply.

- **Blind module for unused slots**

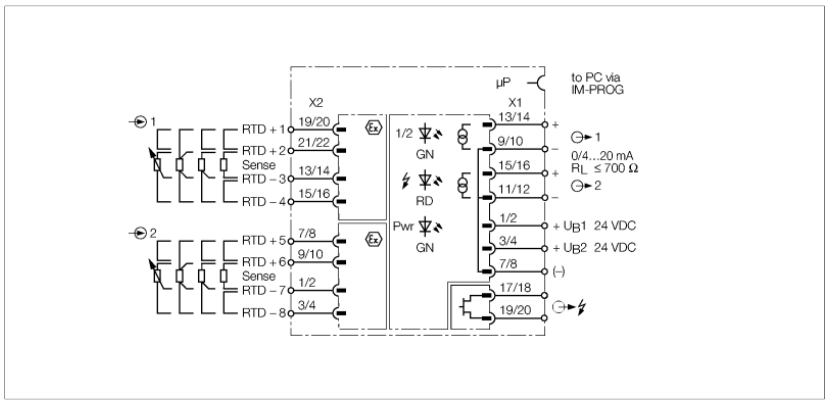
Dummy module
IMB-BM

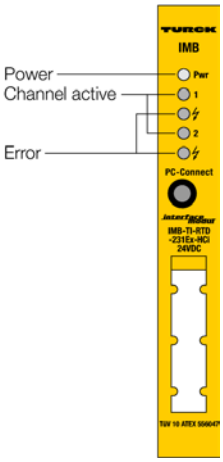
Type	IMB-BM
Ident-No.	7570007
Nominal voltage	24 VDC
Operational voltage range	20…30 VDC
Indication	
Operational readiness	green
Protection class	IP20
Ambient temperature	-25…+70 °C
Dimensions	118 x 18 x 103 mm
Weight	92 g
Mounting instruction	Mounting and operation only in conjunction with the IMB backplane
Housing material	Polycarbonate/ABS

Dimensions



temperature measuring amplifier dual-channel IMB-TI-RTD-231Ex-HCi/24VDC





The dual-channel temperature measuring amplifier IMB-Ti-22Ex-Hi/24VDC is designed to evaluate the temperature-dependent changes of Ni100/Pt100 resistors and to output them as linear current signals of 0/4…20mA.

Resistance thermo detectors Ni100/Pt100 in 2, 3 or 4-wire-technology can be operated alternatively at the input circuit of the measuring amplifier.

PC parameterization and configuration are implemented with the software tool „Device Type Manager“ (DTM). For this purpose the temperature measuring amplifier is connected to the PC with a 3.5-mm front panel jack.

The premoulded transmission cable can be ordered at TURCK under the type name IM-PROG (ident no. 6890422).

Alternatively the device can be parameterized with the HART® protocol via the current interface and a multiplexer.

The following settings can be made with the DTM:

- Connection mode (2, 3 and 4-wire technology)
- Lower measuring range
- Upper measuring range
- Input circuit monitoring for wire-break
- Analog output adjustable in the event of input circuit errors: 0 resp. > 22 mA
- Output current (0/4…20 mA)
- Temperature unit (°C or °K)
- Mode (resistance, line compensation)

The module complies with the EMC requirements acc. to EN61326 and the NAMUR recommendation NE21. Users can switch off one channel of the dual channel IMB-TI devices.

The current output is set to 1 mA in order to maintain the communicability via the HART current loop. Both LEDs related to this channel are switched off. The power LED remains on. The module features wire-break detection. Fault current is provided with open sensor input. The resistor input is equipped with short-circuit detection. If the measured resistance lies outside the characteristic, fault current is output. No short-circuit detection for mV input.

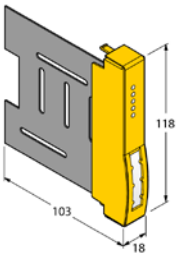
The module features an active alarm. The alarm message is cleared as soon as all slots are assigned and no line error is detected. The green LED indicates operational readiness.

- **Input of PT100/Ni100 resistors in 2 or 3-wire technology**
- **Intrinsically safe input circuits Ex ia Ga IIB/IIC, Ex ia Da IIIC**
- **Application area acc. to ATEX II (1) G, II (1) D**
- **SIL 2**
- **resistance transducer**
- **Galvanically separated input circuits, output circuits and supply voltage**

interface modul

temperature measuring amplifier
dual-channel
IMB-TI-RTD-231Ex-HCi/24VDC

TURCK Industrial Automation

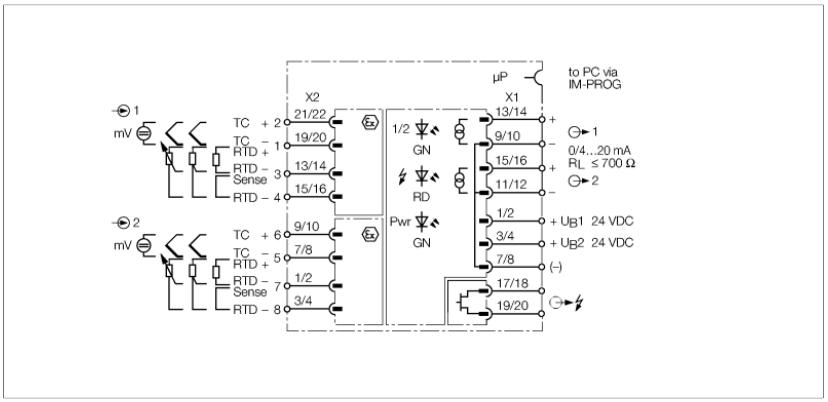


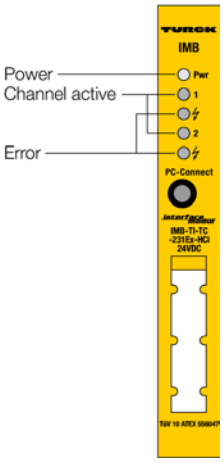
Type	IMB-TI-RTD-231Ex-HCi/24VDC
Ident-No.	7570008
Nominal voltage	24 VDC
Operational voltage range	20…30
Power consumption	≤ 3.2 W
Power loss, typical	≤ 3 W
Input circuits	intrinsically safe according to EN 60079
RTD	PT100 (IEC 751), NI100 (DIN 43760), 2, 3- und 4-Leiter-Technik, nach Gost: PT100, Cu50, Cu53, Cu100,CuZn100,
Probe current	≤ 0.2 mA
Potentiometer input	
Nominal resistance	0…1,5 kΩ
Output circuits	
Output current	0/4...20 mA
Load resistance current output	≤ 0.6 kΩ
Minimum load	≥ 0 Ω
Fault current	0 / 22 mA einstellbar
Rise time (10-90%)	≤ 1000 ms
Dropout time (90…10%)	≤ 1000 ms
Measuring accuracy	≤ 0.1 % of full scale
Temperature drift	≤ 0.01 % / K
Galvanic isolation	
Test voltage	2.5 kV
Ex approval acc. to conformity certificate	TÜV 10 ATEX 556047
Application area	II (1) G, II (1) D
Protection type	[Ex ia Ga] IIB/IIC ; [Ex ia Da] IIIC
Max.output voltage U_o	≤ 5 V
Max. output current I_o	≤ 5 mA
Max. output power P_o	≤ 6.2 mW
Rated voltage	250 V
Characteristic	linear
Internal inductance/capacitance L_i/C_i	Ci = negligibly small, Li = 73µH
External inductance/capacitance L_o/C_o	

Ex ia	IIB			IIC		
Lo[mH]	100	10	1	100	10	1
Co[µF]	10	13	21	1.8	2.4	3.4

Approval	SIL 2
Indication	
Operational readiness	green
Error indication	red
Protection class	IP20
Ambient temperature	-25…+70
Dimensions	118 x 18 x 103
Weight	0 g
Mounting instruction	Mounting and operation only in conjunction with the IMB backplane
Housing material	Polycarbonate/ABS

temperature measuring amplifier
dual-channel
IMB-TI-TC-231Ex-HCi/24VDC





The dual-channel temperature measuring amplifier IMB-Ti-TC-231Ex-Hci/24VDC is designed to evaluate the temperature-dependent variations acc. to IEC 60584, DIN 43710, GOST R 8.585-2001, of RTDs acc. to IEC 60751, DIN 43760, GOST 6651-94 Ni100/Pt100, low voltages in the range of -160…+160 mV as well as RTDS and potentiometers in 2 and 3-wire technology and to output them as linear temperature current signals 0/4…20 mA.

PC parameterization and configuration are implemented with the software tool „Device Type Manager“ (DTM). For this purpose the temperature measuring amplifier is connected to the PC with a 3.5 mm front panel jack. The premoulded transmission cable can be ordered from TURCK under the type name IM-PROG (ident no. 6890422). Alternatively the device can be parameterized with the HART® protocol via the current interface and a multiplexer.

The following settings can be adjusted via DTM:

- Connection mode (2, 3 and 4-wire technology)
- Lower limit
- Upper limit
- Current output adjustable in the event of input circuit errors: 0 resp. > 22 mA
- Output current (0/4…20 mA)
- Temperature unit (°C or °K)
- Mode (resistance, thermoelement, low voltage, line compensation)

The module complies with the EMC requirements acc. to EN61326 and the NAMUR recommendation NE21. Users can switch off one channel of the dual channel IMB-TI devices. The current output is set to 1 mA in order to maintain the communicability via the HART current loop. Both LEDs related to this channel are switched off. The power LED remains on.

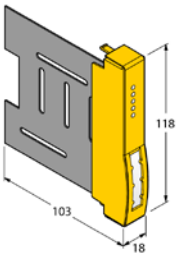
The module features wire-break detection. Fault current is provided with open sensor input. The resistor input is equipped with short-circuit detection. If the measured resistance lies outside the characteristic, fault current is output. No short-circuit detection for mV input. The module features an active alarm. The alarm message is cleared as soon as all slots are assigned and no line error is detected. The green LED indicates operational readiness.

- **Input thermoelements, low voltages, RTD, potentiometer, resistor**
- **Intrinsically safe input circuits Ex ia Ga IIB/IIC, Ex ia Da IIIC**
- **Application area acc. to ATEX II (1) G, II (1) D**
- **SIL 2**
- **resistance transducer**
- **Galvanically separated input circuits, output circuits and supply voltage**

interface modul

temperature measuring amplifier
dual-channel
IMB-TI-TC-231Ex-HCi/24VDC

TURCK Industrial Automation

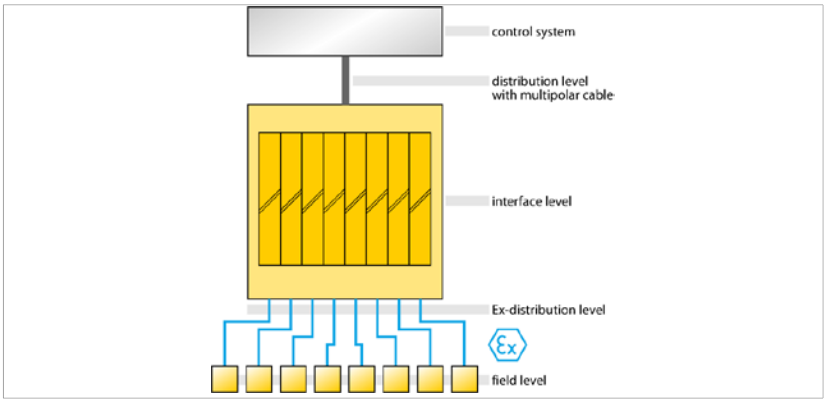


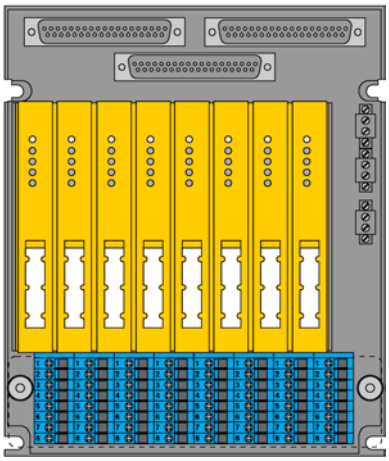
Type	IMB-TI-TC-231Ex-HCi/24VDC
Ident-No.	7570009
Nominal voltage	24 VDC
Operational voltage range	20…30
Power consumption	≤ 2.7 W
Power loss, typical	≤ 2.5 W
Input circuits	intrinsically safe according to EN 60079
RTD	PT100 (IEC 751), NI100 (DIN 43760), 2- und 3-Leiter-Technik, nach Gost: PT100, Cu50, Cu53, Cu100,CuZn100,
Probe current	≤ 0.2 mA
Thermoelements	B, E, J, K, N, R, S, T (ITS 90/IEC 584), L (DIN 43710), acc. to Gost: L, M, A1, A2, A3
Potentiometer input	
Nominal resistance	0…1 kΩ
Voltage	-160…+160 VDC
Output circuits	
Output current	0/4...20 mA
Load resistance current output	≤ 0.6 kΩ
Minimum load	≥ 0 Ω
Fault current	0 / 22 mA einstellbar
Rise time (10-90%)	≤ 1000 ms
Dropout time (90…10%)	≤ 1000 ms
Measuring accuracy	≤ 0.1 % of full scale
Temperature drift	≤ 0.01 % / K
Galvanic isolation	
Test voltage	2.5 kV
Ex approval acc. to conformity certificate	TÜV 10 ATEX 556047
Application area	II (1) G, II (1) D
Protection type	[Ex ia Ga] IIB/IIC ; [Ex ia Da] IIIC
Max.output voltage U_o	≤ 5 V
Max. output current I_o	≤ 5 mA
Max. output power P_o	≤ 6.2 mW
Rated voltage	250 V
Characteristic	linear
Internal inductance/capacitance L_i/C_i	Ci = negligibly small, Li = 73µH
External inductance/capacitance L_o/C_o	

Ex ia	IIB			IIC		
Lo[mH]	100	10	1	100	10	1
Co[µF]	10	13	21	1.8	2.4	3.4

Approval	SIL 2
Indication	
Operational readiness	green
Error indication	red
Protection class	IP20
Ambient temperature	-25…+70
Dimensions	118 x 18 x 103
Weight	0 g
Mounting instruction	Mounting and operation only in conjunction with the IMB backplane
Housing material	Polycarbonate/ABS

Backplane for Honeywell C300
IMB-BP-8-H-IN





- **Backplane for Honeywell C300 input signals**
- **Backplane without active electronic components, no approval required**
- **High channel density, up to 32 channels per backplane**
- **Up to 36 backplanes per control cabinet**
- **Hot-swappable cards for easy and comfortable maintenance**
- **Connection of a HART® multiplexer to parameterize intelligent HART® field devices via Y-junction**

The Interfacemodul-Backplane (IMB) helps you to arrange the cabinet components in a smart way. A dense population of channels saves space, you gain a rugged and high-temperature resistant arrangement which is at the same time easy to handle. Up to eigth interface modules have space on the 175 x 210 mm IMB backplane: I/O modules, HART® transmissible analog cards and DTM parametrizable temperature measuring amplifiers. The backplane can take up to 32 digital or 16 analog inputs and outputs can be arranged. The I/O channels are galvanically separated by the interface cards.

The backplane is a purely passive unit, applied as a patch panel for I/O solutions. There are no active components on it, because any failure of these would lead to a complete outage of the isolation level. Each interface card is additionally safeguarded.

The backplane accommodates the entire connection level of the IMB system: The 8 slots for the interface cards as well as connection possibilities for the inputs, outputs, the system cable and the power supply. The intrinsically safe field circuits are connected via screw terminals and the control system is connected via premoulded system cables.

The IMB can be fed redundantly via two separate power supply units, whereby the electronics on the plug-in cards ensures safe electrical separation of both. Two removable terminal blocks on the backplane are intended for power supply.

The IMB interface cards are equipped with a power-on LED and some also feature status LEDs indicating the operating mode. The I/O level is thus controlable from the cabinet.

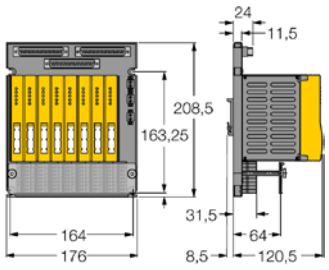
The backplane is snapped on the DIN rail with an adapter acc. to DIN EN 60715 TH35. The adapter can be mounted in different ways, allowing the IMB system to be installed horizontally or vertically on the DIN rail. The backplanes can also be mounted side by side to accommodate several IMB systems.

Alternatively, the DIN rail socket can be removed and the backplane can be mounted directly on a support plate with four screws.

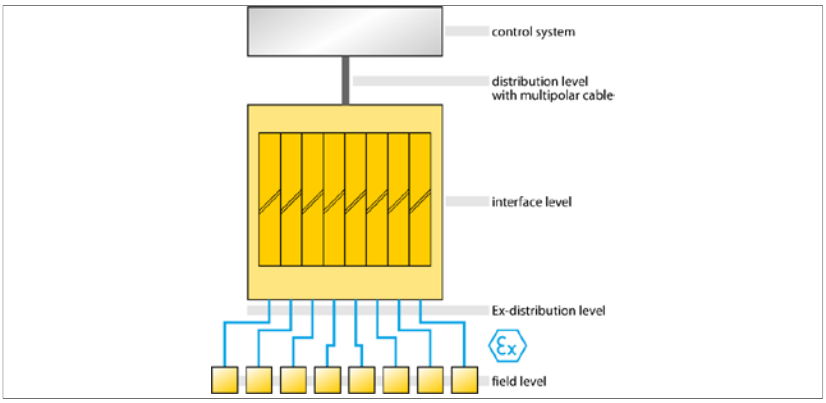
A fixture for a lable is located above the terminals.

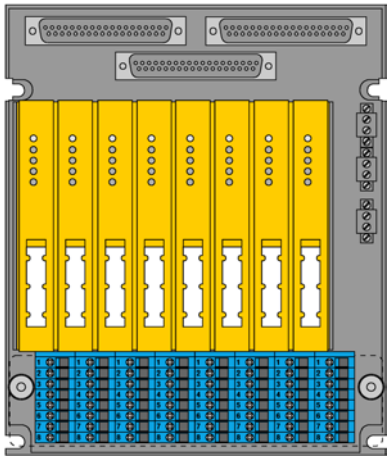
Backplane for Honeywell C300
IMB-BP-8-H-IN

Type	IMB-BP-8-H-IN
Ident-No.	7570021
Protection class	IP20
Ambient temperature	-25…+70 °C
Dimensions	176 x 120 x 208 mm
Weight	0 g
Mounting instruction	Mounting on DIN rail or mounting panel
Housing material	Polycarbonate/ABS



Backplane for Honeywell C300
IMB-BP-8-H-OUT





The Interfacemodul-Backplane (IMB) helps you to arrange the cabinet components in a smart way. A dense population of channels saves space, you gain a rugged and high-temperature resistant arrangement which is at the same time easy to handle. Up to eigth interface modules have space on the 175 x 210 mm IMB backplane: I/O modules, HART® transmissible analog cards and DTM parametrizable temperature measuring amplifiers. The backplane can take up to 32 digital or 16 analog inputs and outputs can be arranged. The I/O channels are galvanically separated by the interface cards.

The backplane is a purely passive unit, applied as a patch panel for I/O solutions. There are no active components on it, because any failure of these would lead to a complete outage of the isolation level. Each interface card is additionally safeguarded.

The backplane accommodates the entire connection level of the IMB system: The 8 slots for the interface cards as well as connection possibilities for the inputs, outputs, the system cable and the power supply. The intrinsically safe field circuits are connected via screw terminals and the control system is connected via premoulded system cables.

The IMB can be fed redundantly via two separate power supply units, whereby the electronics on the plug-in cards ensures safe electrical separation of both. Two removable terminal blocks on the backplane are intended for power supply.

The IMB interface cards are equipped with a power-on LED and some also feature status LEDs indicating the operating mode. The I/O level is thus controlable from the cabinet.

The backplane is snapped on the DIN rail with an adapter acc. to DIN EN 60715 TH35. The adapter can be mounted in different ways, allowing the IMB system to be installed horizontally or vertically on the DIN rail. The backplanes can also be mounted side by side to accommodate several IMB systems.

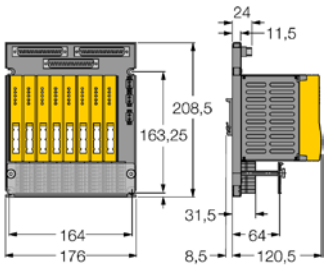
Alternatively, the DIN rail socket can be removed and the backplane can be mounted directly on a support plate with four screws.

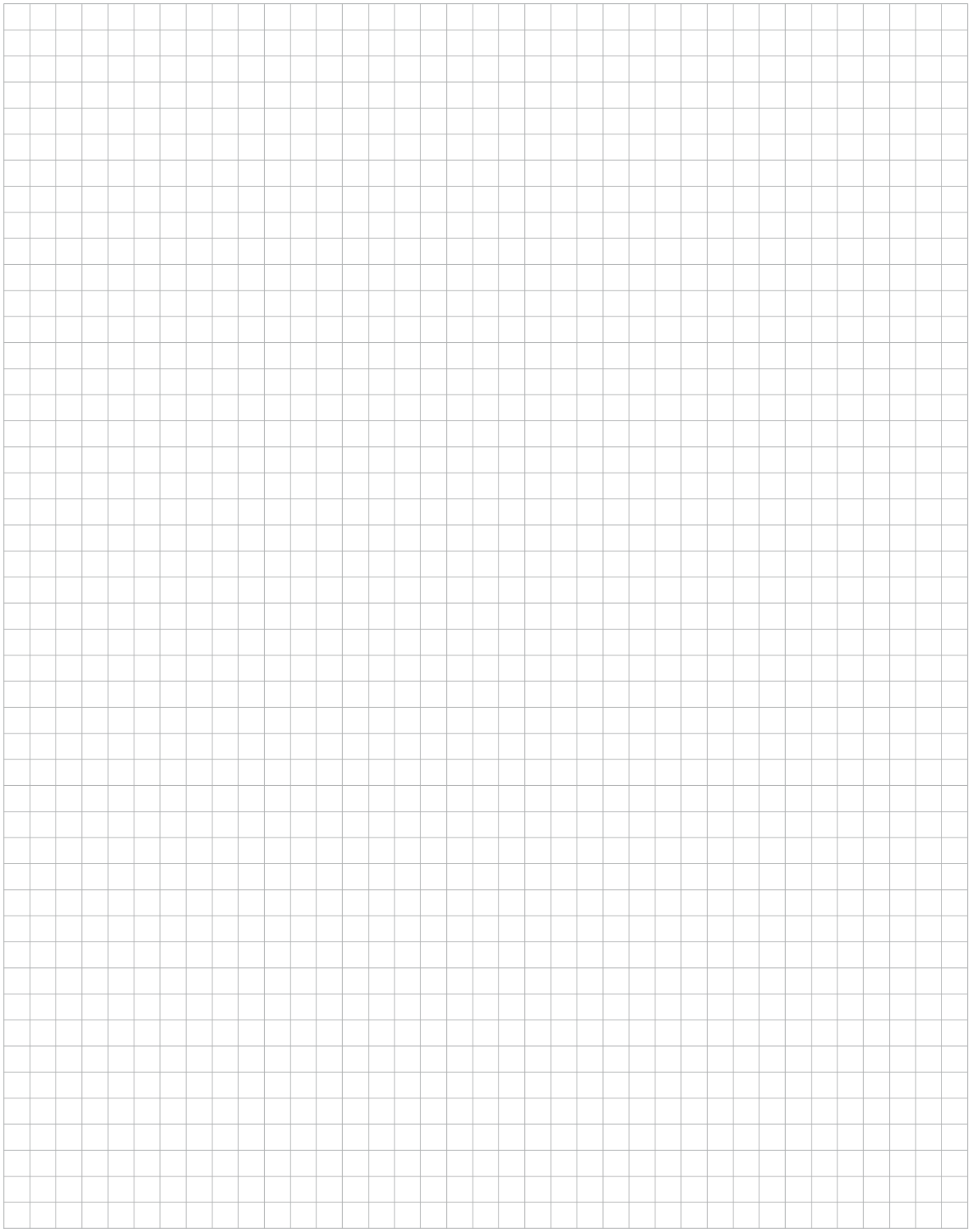
A fixture for a lable is located above the terminals.

- **Backplane for Honeywell C300 output signals**
- **Backplane without active electronic components, no approval required**
- **High packing density, up to 32 channels per backplane**
- **Up to 36 backplanes per control cabinet**
- **Hot-swappable cards for easy and comfortable maintenance**
- **Connection of a HART® multiplexer to parameterize intelligent HART® field devices via Y-junction**

Backplane for Honeywell C300
IMB-BP-8-H-OUT

Type	IMB-BP-8-H-OUT
Ident-No.	7570022
Protection class	IP20
Ambient temperature	-25…+70 °C
Dimensions	176 x 120 x 208 mm
Weight	0 g
Mounting instruction	Mounting on DIN rail or mounting panel
Housing material	Polycarbonate/ABS





9 Appendix: SIL certificates

Failure Modes, Effects and Diagnostic Analysis

Project:
IMB-series interface modules:
Analog signal transmitter IMB-AI-22Ex-Hi/24VDC
Analog data transmitter IMB-AO-22Ex-Hi/24VDC
Isolating transducer IMB-AIA-22Ex-Hi/24VDC
Solenoid valve driver IMB-DO-44Ex/24VDC
Isolating switching amplifier IMB-DI-451Ex-P/24VDC

Customer:

Hans Turck GmbH & Co. KG
Mühlheim
Germany

Contract No.: TURCK 09/09-10
Report No.: TURCK 09/09-10 R009
Version V1, Revision R0; January 2010

Stephan Aschenbrenner, Alexander Dimov

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Management summary

This report summarizes the results of the hardware assessment carried out on the following IMB-series interface modules listed in Table 1.

Table 1: Overview of considered IMB-series interface modules

Function	Description
Analog signal transmitter	IMB-AI-22Ex-Hi/24VDC
Analog data transmitter	IMB-AO-22Ex-Hi/24VDC
Isolating transducer	IMB-AIA-22Ex-Hi/24VDC
Solenoid valve driver/intrinsically safe power supply	IMB-DO-44Ex//24VDC
Isolating switching amplifier	IMB-DI-451Ex-P/24VDC

The hardware assessment consists of a Failure Modes, Effects and Diagnostics Analysis (FMEDA). A FMEDA is one of the steps taken to achieve functional safety assessment of a device per IEC 61508. From the FMEDA, failure rates are determined and consequently the Safe Failure Fraction (SFF) is calculated for the device. For full assessment purposes all requirements of IEC 61508 must be considered.

The failure rates used in this analysis are from the *exida* Electrical & Mechanical Component Reliability Handbook for Profile 1. The analysis has been carried out with the basic failure rates from the Siemens standard SN 29500. However as the comparison between these two databases has shown that the differences are within an acceptable tolerance the failure rates of the *exida* database are listed.

For safety applications only the described devices were considered. All other possible output variants or electronics are not covered by this report.

A user of the IMB-series interface modules can utilize these failure rates in a probabilistic model of a safety instrumented function (SIF) to determine suitability in part for safety instrumented system (SIS) usage in a particular safety integrity level (SIL). A full table of failure rates is presented in sections 4.3.1 to 4.3.5 along with all assumptions.

The IMB-series interface modules are considered to be Type A[1] subsystems with a hardware fault tolerance of 0.

[1] Type A subsystem: "Non-complex" subsystems (all failure modes are well defined); for details see 7.4.3.1.2 of IEC 61508-2.

Table 2 Summary IMB-AI-22Ex-Hi/24VDC – IEC 61508 failure rates

	***exida* Profile 1** [2]
Failure category	**Failure rates (in FIT)**
Fail Safe Detected (λ_{SD})	**0**
Fail safe detected	0
Fail Safe Undetected (λ_{SU})	**128**
Fail safe undetected	0
No effect	128
Annunciation undetected (95%)	0
Fail Dangerous Detected (λ_{DD})	**168**
Fail detected (detected by internal diagnostics)	0
Fail low (detected by safety logic solver)	161
Fail high (detected by safety logic solver)	7
Annunciation detected	0
Fail Dangerous Undetected (λ_{DU})	**17**
Fail dangerous undetected	17
Annunciation undetected (5%)	0
No part	66

Total failure rate (safety function)	**313 FIT**
SFF [3]	**94%**
DC_D	**91%**
MTBF	**301 years**

SIL AC [4]	**SIL 3**

The failure rates are valid for the useful life of the IMB-AI-22Ex-Hi/24VDC interface module (see Appendix 2).

[2] For details see Appendix 3.

[3] The complete final element subsystem will need to be evaluated to determine the overall Safe Failure Fraction. The number listed is for reference only.

[4] SIL AC (architectural constraints) means that the calculated values are within the range for hardware architectural constraints for the corresponding SIL but does not imply all related IEC 61508 requirements are fulfilled.

Table 3: Summary IMB-AO-22Ex-Hi/24VDC – IEC 61508 failure rates

	exida **Profile 1** [5]
Failure category	**Failure rates (in FIT)**
Fail Safe Detected (λ_{SD})	**0**
Fail safe detected	0
Fail Safe Undetected (λ_{SU})	**550**
Fail safe undetected	0
Fail low	292
No effect	258
Annunciation undetected (95%)	0
Fail Dangerous Detected (λ_{DD})	**0**
Fail detected (detected by internal diagnostics)	0
Fail high	0
Annunciation detected	0
Fail Dangerous Undetected (λ_{DU})	**43**
Fail dangerous undetected	43
Annunciation undetected (5%)	0
No part	102

Total failure rate (safety function)	**593 FIT**
SFF [6]	**92%**
DC_D	**0%**
MTBF	**164 years**

SIL AC [7]	**SIL 3**

The failure rates are valid for the useful life of the IMB-AO-22Ex-Hi interface module (see Appendix 2).

[5] For details see Appendix 3.

[6] The complete final element subsystem will need to be evaluated to determine the overall Safe Failure Fraction. The number listed is for reference only.

[7] SIL AC (architectural constraints) means that the calculated values are within the range for hardware architectural constraints for the corresponding SIL but does not imply all related IEC 61508 requirements are fulfilled.

Table 4: Summary IMB-AIA-22Ex-Hi/24VDC – IEC 61508 failure rates

	exida Profile 1 [8]
Failure category	**Failure rates (in FIT)**
Fail Safe Detected (λ_{SD})	**0**
Fail safe detected	0
Fail Safe Undetected (λ_{SU})	**143**
Fail safe undetected	0
No effect	143
Annunciation undetected (95%)	0
Fail Dangerous Detected (λ_{DD})	**193**
Fail detected (detected by internal diagnostics)	0
Fail low (detected by safety logic solver)	190
Fail high (detected by safety logic solver)	3
Annunciation detected	0
Fail Dangerous Undetected (λ_{DU})	**46**
Fail dangerous undetected	46
Annunciation undetected (5%)	0
No part	40

Total failure rate (safety function)	**382 FIT**
SFF [9]	**87%**
DC_D	**81%**
MTBF	**271 years**

SIL AC [10]	**SIL 2**

The failure rates are valid for the useful life of the IMB-AIA-22Ex-Hi/24V interface module (see Appendix 2).

[8] For details see Appendix 3.

[9] The complete final element subsystem will need to be evaluated to determine the overall Safe Failure Fraction. The number listed is for reference only.

[10] SIL AC (architectural constraints) means that the calculated values are within the range for hardware architectural constraints for the corresponding SIL but does not imply all related IEC 61508 requirements are fulfilled.

Table 5: Summary IMB-DO-44Ex/24VDC – IEC 61508 failure rates

	exida Profile 1 [11]
Failure category	**Failure rates (in FIT)**
Fail Safe Detected (λ_{SD})	**0**
Fail safe detected	0
Fail Safe Undetected (λ_{SU})	**487**
Fail safe undetected	254
No effect	233
Annunciation undetected (95%)	0
Fail Dangerous Detected (λ_{DD})	**0**
Fail detected (detected by internal diagnostics)	0
Annunciation detected	0
Fail Dangerous Undetected (λ_{DU})	**15**
Fail dangerous undetected	15
Annunciation undetected (5%)	0
No part	91

Total failure rate (safety function)	**502 FIT**
SFF [12]	**97%**
DC_D	**0%**
MTBF	**192 years**

SIL AC [13]	**SIL 3**

The failure rates are valid for the useful life of the IMB-DO-44Ex/24VDC interface module (see Appendix 2).

[11] For details see Appendix 3.

[12] The complete final element subsystem will need to be evaluated to determine the overall Safe Failure Fraction. The number listed is for reference only.

[13] SIL AC (architectural constraints) means that the calculated values are within the range for hardware architectural constraints for the corresponding SIL but does not imply all related IEC 61508 requirements are fulfilled.

Table 6: Summary IMB-DI-451Ex-P/24VDC – IEC 61508 failure rates

	exida Profile 1 [14]
Failure category	**Failure rates (in FIT)**
Fail Safe Detected (λ_{SD})	**0**
Fail safe detected	0
Fail Safe Undetected (λ_{SU})	**373**
Fail safe undetected	273
No effect	100
Annunciation undetected (95%)	0
Fail Dangerous Detected (λ_{DD})	**0**
Fail detected (detected by internal diagnostics)	0
Annunciation detected	0
Fail Dangerous Undetected (λ_{DU})	**78**
Fail dangerous undetected	78
Annunciation undetected (5%)	0
No part	41

Total failure rate (safety function)	**451 FIT**
SFF [15]	**83%**
DC_D	**0%**
MTBF	**232 years**

SIL AC [16]	**SIL 2**

The failure rates are valid for the useful life of the IMB-DI-451Ex-P/24VDC interface module (see Appendix 2).

[14] For details see Appendix 3.

[15] The complete final element subsystem will need to be evaluated to determine the overall Safe Failure Fraction. The number listed is for reference only.

[16] SIL AC (architectural constraints) means that the calculated values are within the range for hardware architectural constraints for the corresponding SIL but does not imply all related IEC 61508 requirements are fulfilled.

Failure Modes, Effects and Diagnostic Analysis

Project:

Temperature measuring amplifier IMB-TI-***-**1Ex-HCi/24VDC

Customer:

Hans Turck GmbH & Co. KG
Mühlheim
Germany

Contract No.: TURCK 10/05-060
Report No.: TURCK 10/05-060 R011
Version V1, Revision R0; November 2010

Stephan Aschenbrenner

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Management summary

This report summarizes the results of the hardware assessment carried out on the temperature measuring amplifier IMB-TI-***-**1Ex-HCi/24VDC with software version V1.0 and hardware version as listed in the circuit diagram referenced in section 2.4.1. Table 1 gives an overview of the considered configurations of the temperature measuring amplifier IMB-TI-***-**1Ex-HCi/24VDC.

The hardware assessment consists of a Failure Modes, Effects and Diagnostics Analysis (FMEDA). A FMEDA is one of the steps taken to achieve functional safety assessment of a device per IEC 61508. From the FMEDA, failure rates are determined and consequently the Safe Failure Fraction (SFF) is calculated for the device. For full assessment purposes all requirements of IEC 61508 must be considered.

Table 1: Overview of the considered configurations

	Type	**Description** [1]
[C1]	IMB-TI-RTD-121Ex-HCi/24VDC	1 channel with RTD input
[C2]	IMB-TI-RTD-231Ex-HCi/24VDC	2 channels with RTD input
[C3]	IMB-TI-TC-121Ex-HCi/24VDC	1 channel with TC input
[C4]	IMB-TI-TC-231Ex-HCi/24VDC	2 channels with TC input

For safety applications only the described version of the device was considered. All other possible output variants or electronics are not covered by this report.

The failure rates used in this analysis are from the *exida* Electrical & Mechanical Component Reliability Handbook for Profile 1.

A user of the IMB-series interface modules can utilize these failure rates in a probabilistic model of a safety instrumented function (SIF) to determine suitability in part for safety instrumented system (SIS) usage in a particular safety integrity level (SIL). A full table of failure rates is presented in section 4.3.1 along with all assumptions.

The temperature measuring amplifier IMB-TI-***-**1Ex-HCi/24VDC is considered a Type B[2] subsystem with a hardware fault tolerance of 0.

The FMEDA was carried out considering the worst-case input configuration. The following table shows the results.

[1] The two channels on the redundant boards shall not be used in the same safety function, e.g. to increase the hardware fault tolerance to achieve a higher SIL, as they contain common components. The FMEDA applies to either channel used in a single safety function. The two channels may be used in separate safety functions if due regard is taken of the possibility of common failures.

[2] Type B subsystem: "Complex" subsystem (using micro controllers or programmable logic); for details see 7.4.3.1.3 of IEC 61508-2.

Table 2 Summary IMB-TI-*-**1Ex-HCi/24VDC – IEC 61508 failure rates**

Failure category	*exida* Profile 1 [3]
Fail Safe Detected (λ_{SD})	**0**
Fail Safe Undetected (λ_{SU})	**0**
Fail Dangerous Detected (λ_{DD})	**651**
Fail Dangerous Detected (λ_{dd})	387
Fail High (λ_{H})	11
Fail Low (λ_{L})	253
Fail Dangerous Undetected (λ_{DU})	**59**
Fail Annunciation Detected (λ_{AD})	0
Fail Annunciation Undetected (λ_{AU})	52
No effect	153
No part	117

Total failure rate of the safety function (λ_{Total})	**710 FIT**
Safe failure fraction (SFF) [4]	**91%**
DC_D	**91%**

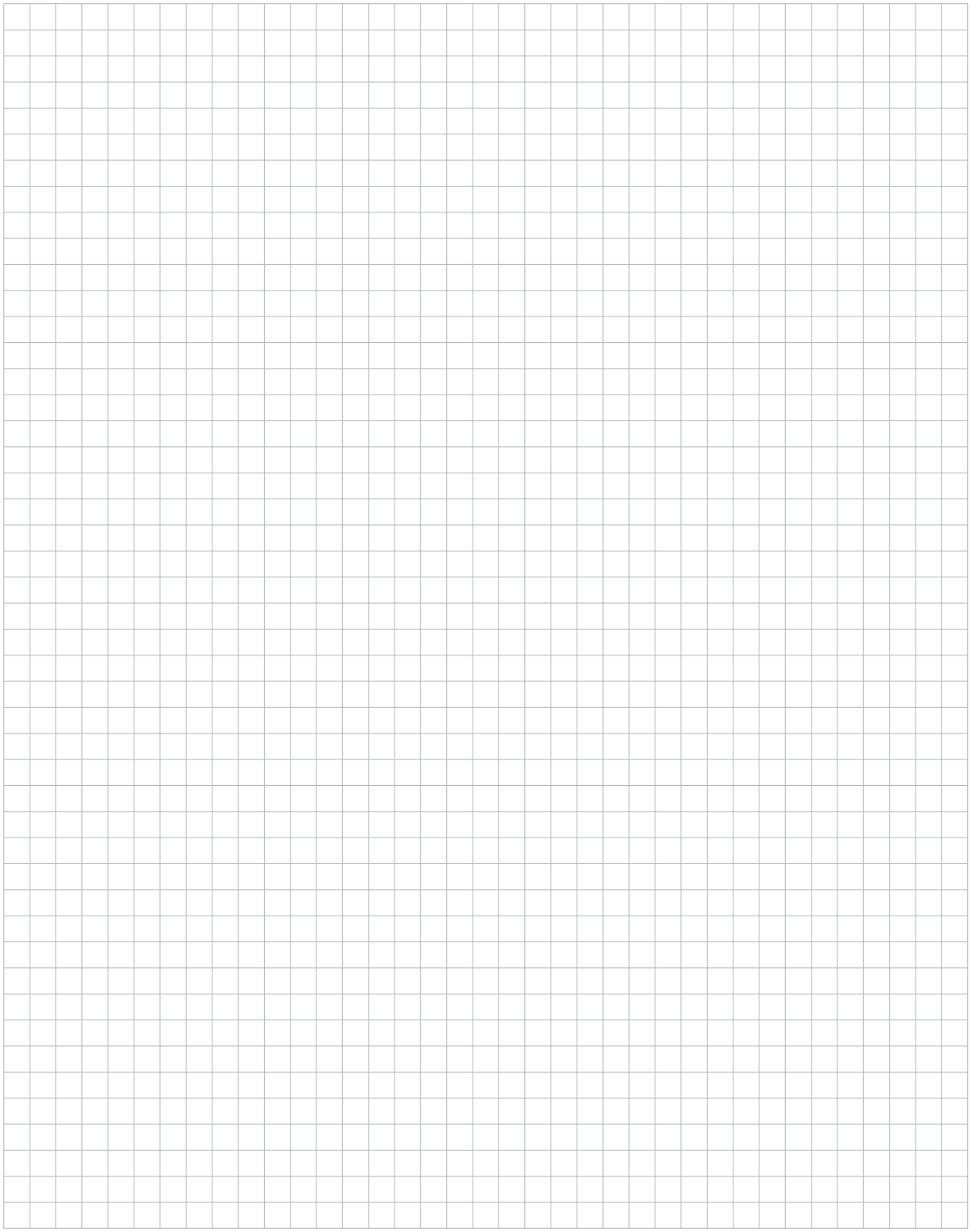
SIL AC [5]	**SIL 2**

The failure rates are valid for the useful life of the temperature measuring amplifier IMB-TI-***-**1Ex-HCi/24VDC (see Appendix 2).

[3] For details see Appendix 3.

[4] The complete sensor subsystem will need to be evaluated to determine the overall Safe Failure Fraction. The number listed is for reference only.

[5] SIL AC (architectural constraints) means that the calculated values are within the range for hardware architectural constraints for the corresponding SIL but does not imply all related IEC 61508 requirements are fulfilled.



10 Appendix: EC-type examination certificates

Translation

(1) EC-Type Examination Certificate

(2) Equipment and protective systems intended for use in potentially explosive atmospheres, **Directive 94/9/EC**

(3)	**Certificate Number**	**TÜV 08 ATEX 554880**
(4)	for the equipment:	Isolating switch amplifier type IMB-DI-***Ex-***/24VDC
(5)	of the manufacturer:	Hans Turck GmbH & Co. KG
(6)	Address:	Witzlebensstraße 7 45472 Mülheim (Ruhr) Germany
	Order number:	8000554880
	Date of issue:	2008-12-10

(7) This equipment or protective system and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) The TÜV NORD CERT GmbH, notified body No. 0044 in accordance with Article 9 of the Council Directive of the EC of March 23, 1994 (94/9/EC), certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive. The examination and test results are recorded in the confidential report No. 08 203 554880.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 60079-0:2006 EN 60079-11:2007 EN 61 241-0:2006 EN 61 241-11:2006

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-type examination certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(12) The marking of the equipment or protective system must include the following:

⟨Ex⟩ II (1) G [Ex ia] IIC/IIB resp. II (1) D [Ex iaD]

TÜV NORD CERT GmbH, Langemarckstraße 20, 45141 Essen, accredited by the central office of the countries for safety engineering (ZLS), Ident. Nr. 0044, legal successor of the TÜV NORD CERT GmbH & Co. KG Ident. Nr. 0032

The head of the certification body

Schwedt

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(13) **S C H E D U L E**

(14) **EC-Type Examination Certificate No. TÜV 08 ATEX 554880**

(15) Description of equipment

The isolating switch amplifier type IMB-DI-***Ex-***/24VDC is used for the transmission of binary signals out of the explosion hazardous area into the non explosion hazardous area as well as for the safe galvanic separation between the intrinsically safe and the non intrinsically safe circuits.

The intrinsically safe circuits may also be connected to devices for the use in dust explosive areas if the devices are certified accordingly.

The device is executed with 4 channels.

The permissible ambient temperature range is -25°C ... 70°C.

Electrical Data

Supply circuit ..... (X1-contact 1/2[+] resp. 3/4[+], 7/8[-])	U = 24 V d.c. (max. 30 V d.c.), ca. 2W U_m = 250 V a.c. resp. 125 V d.c.
Output circuits Channel output..... (X1-contact (9/10 [+] resp. 11/12 [+] resp. 13/14 [+] resp. 15/16 [+], 7/8[-])	U = 20V d.c. ca. 3mA, switching of power U_m = 250 Va.c.
Failure signal output (X1-contact (17/18, 19/20)	U = 20V d.c. ca. 3mA isolated U_m = 250 V a.c. resp. 125 V d.c.
Input circuits..... (X2-contact 1/2,3/4 7/8, 9/10 13/14, 15/16 19/20/21/22)	in type of protection Intrinsic Safety Ex ia IIC/IIB resp. Ex iaD Maximum values per channel: U_o = 12 V I_o = 12.4 mA P_o = 37.2 mW Characteristic line: linear Effective internal inductance L_i = 76,5µH Effective internal capacitance C_i = negligibly small.

Ex ia	IIC		IIB	
max. permissible external inductance	10 mH	0.92 mH	20 mH	1.92 mH
max. permissible external capacitance	0.49 µF	0.78 µF	2.2 µF	3.6 µF

The maximum values of the table are also allowed to be used up to the permissible limits as concentrated capacitances and as concentrated inductances.

The intrinsically safe circuits are galvanically connected with each other. The intrinsically safe input circuits are safely galvanically separated from the non intrinsically safe circuits up to the peak crest value of the voltage of 375 V.

Schedule EC-Type Examination Certificate No. TÜV 08 ATEX 554880

(16) Test documents are listed in the test report No. 08 203 554880.

(17) Special conditions for safe use

none

(18) Essential Health and Safety Requirements

no additional ones

Hans Turck GmbH & Co. KG ▪ Tel. +49 (208) 4952-0 ▪ Fax +49 (208) 4952-264

Translation

1. SUPPLEMENT

to Certificate No.	**TÜV 08 ATEX 554880**
Equipment:	Isolating switch amplifier type IMB-DI-***Ex-***/24VDC
Manufacturer:	Hans Turck GmbH & Co. KG
Address:	Witzlebenstraße 7 45472 Mülheim an der Ruhr, Germany
Order number:	8000556179
Date of issue:	19.10.2010

In the future, the marking of the isolating switch amplifier type IMB-DI-***Ex-***/24VDC reads as follows:
II (1) G [Ex ia Ga] IIC and II (1) D [Ex ia Da] IIIC

Electrical data

Input circuits..... in type of protection
Intrinsic Safety Ex ia IIC/IIB resp. Ex ia IIIC

(X2-contact 1/2,3/4
7/8, 9/10
13/14, 15/16
19/20, 21/22)

Maximum values per channel:
U_o = 12 V
I_o = 12.4 mA
P_o = 37.2 mW
Characteristic line: linear
Effective internal inductance L_i = 76.5µH
The effective internal capacitance is negligibly small.

Ex ia	IIC		IIB	
max. permissible external inductance	10 mH	0.92 mH	20 mH	1.92 mH
max. permissible external capacitance	0.49 µF	0.78 µF	2.2 µF	3.6 µF

The values for IIB and for IIC are also permissible for explosive dust atmospheres.

The maximum values of the table are also allowed to be used up to the permissible limits as concentrated capacitances and as concentrated inductances.

The intrinsically safe circuits are galvanically connected with each other. The intrinsically safe input circuits are safely galvanically separated from the non intrinsically safe circuits up to the peak value of the voltage of 375 V.

All other details remain unchanged.

The equipment according to this supplement meets the requirements of these standards:

EN 60 079-0:2009 EN 60 079-11:2007 EN 61241-11: 2006

(16) The test documents are listed in the test report No. 10 203 556179.

(17) Special conditions for safe use

none

(18) Essential Health and Safety Requirements

no additional ones

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Translation

(1) EC-Type Examination Certificate

(2) Equipment and protective systems intended for use in potentially explosive atmospheres, **Directive 94/9/EC**

(3)	**Certificate Number**	**TÜV 09 ATEX 554858**
(4)	for the equipment:	Isolating amplifier type IMB-AI-**Ex-Hi/24VDC
(5)	of the manufacturer:	Hans Turck GmbH & Co. KG
(6)	Address:	Witzlebensstraße 7 45472 Mülheim (Ruhr) Germany
	Order number:	8000554858
	Date of issue:	2009-06-16

(7) This equipment or protective system and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) The TÜV NORD CERT GmbH, notified body No. 0044 in accordance with Article 9 of the Council Directive of the EC of March 23, 1994 (94/9/EC), certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive. The examination and test results are recorded in the confidential report No. 09 203 554858.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 60079-0:2006 EN 60079-11:2007 EN 61 241-0:2006 EN 61 241-11:2006

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-type examination certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(12) The marking of the equipment or protective system must include the following:

Ex **II (1) G [Ex ia] IIC/IIB resp. II (1) D [Ex iaD]**

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(13) **S C H E D U L E**

(14) **EC-Type Examination Certificate No. TÜV 09 ATEX 554858**

(15) Description of equipment

The isolating amplifier type IMB-AI-**Ex-Hi/24VDC is used for the transmission of active intrinsically safe input signals into passive output signals as well as for the safe galvanic separation between the intrinsically safe and the non intrinsically safe circuits

The intrinsically safe circuits may also be connected to devices for the use in dust explosive areas if the devices are certified accordingly.

The device is executed with 2 channels.

The permissible ambient temperature range at the device is -25°C ... 70°C.

Electrical Data

Supply circuit..... (X1-contact 1/2[+] resp. 3/4[+], 7/8[-])	U = 24 V d.c. (max. 30 V d.c.), ca. 2W U_m = 250 V a.c. resp. d.c.
Output circuits (X1-contact 13/14 [+]..... resp. 15/16 [+], 9/10/11/12 [-])	U = 13.3 V d.c., 4...20mA U_m = 250 V a.c. resp. d.c.
Input circuits..... (X2-contact 13/14[+],15/16[-], resp. 19/20[+], 21/22[-]),	in type of protection Intrinsic Safety Ex ia IIC/IIB resp. Ex iaD Maximum values per channel: U_i = 27 V I_i = 150 mA P_i = 1 W The effective internal inductances and capacitances are negligibly small.

For safety reasons, the input circuits have to be considered as passive.

The maximum values for L_O and C_O, which are permissible in the input circuit, have to be taken from the certificate of the connected apparatus.

The intrinsically safe input circuits are safely galvanically separated from the non intrinsically safe circuits up to the peak crest value of the voltage of 375 V.

(16) Test documents are listed in the test report No. 09 203 554858.

(17) Special conditions for safe use

none

(18) Essential Health and Safety Requirements

no additional ones

Translation

1. SUPPLEMENT

to Certificate No.	**TÜV 09 ATEX 554858**
Equipment:	Isolating amplifier type IMB-AI-**Ex-Hi/24VDC
Manufacturer:	Hans Turck GmbH & Co. KG
Address:	Witzlebenstraße 7 45472 Mülheim an der Ruhr, Germany
Order number:	8000556166
Date of issue:	2010-10-11

In the future, the marking of the isolating amplifier type IMB-AI-**Ex-Hi/24VDC reads as follows:

II (1) G [Ex ia Ga] IIC and II (1) D [Ex ia Da] IIIC

Input circuits ..... (X2-contact 13/14[+],15/16[-], resp. 19/20[+], 21/22[-])	in type of protection Intrinsic Safety Ex ia IIC/IIB resp. Ex ia IIIC Maximum values per channel: U_i = 27 V I_i = 150 mA P_i = 1 W The effective internal inductances and capacitances are negligibly small.

For safety reasons, the input circuits have to be considered as passive.

The maximum values for L_O and C_O, which are permissible in the input circuit, have to be taken from the certificate of the connected apparatus.

The L_o and C_o values for IIB and for IIC of the connected apparatus are also permissible for explosive dust atmospheres.

The intrinsically safe input circuits are safely galvanically separated from the non intrinsically safe circuits up to the peak value of the voltage of 375 V.

All other details remain unchanged.

The equipment according to this supplement meets the requirements of these standards:

EN 60 079-0:2009 EN 60 079-11:2007 EN 61241-11: 2006

(16) The test documents are listed in the test report No. 10 203 556166.

(17) Special conditions for safe use

none

(18) Essential Health and Safety Requirements

no additional ones

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Translation

(1) EC-Type Examination Certificate

(2) Equipment and protective systems intended for use in potentially explosive atmospheres, **Directive 94/9/EC**

(3)	**Certificate Number**	**TÜV 09 ATEX 554881**
(4)	for the equipment:	Transmitter power supply type IMB-AIA-22Ex-Hi/24VDC
(5)	of the manufacturer:	Hans Turck GmbH & Co. KG
(6)	Address:	Witzlebenstraße 7 45472 Mülheim Germany
	Order number:	8000554801
	Date of issue:	2009-06-26

(7) This equipment or protective system and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) The TÜV NORD CERT GmbH, notified body No. 0044 in accordance with Article 9 of the Council Directive of the EC of March 23, 1994 (94/9/EC), certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive. The examination and test results are recorded in the confidential report No. 09 203 554881.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 60079-0:2006 EN 60079-11:2007 EN 61 241-0:2006
EN 61 241-11:2006

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-type examination certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(12) The marking of the equipment or protective system must include the following:

II (1) G [Ex ia] IIB resp. II (1) D [Ex iaD]

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The head of the certification body

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(13) **S C H E D U L E**

(14) **EC-Type Examination Certificate No. TÜV 09 ATEX 554881**

(15) Description of equipment

The transmitter power supply type IMB-AIA-22Ex-Hi/24VDC is used for the safe galvanic separation between the intrinsically safe supply circuits and the non intrinsically safe circuits.
It is also used for the supply of apparatus in the explosion hazardous area and for signal transmission.
The transmitter power supply is executed with 2 channels.
The intrinsically safe supply circuits may also be connected to apparatus in explosion hazardous areas caused by dust, which are certified accordingly.

The permissible ambient temperature range is -25°C ... 70°C.

Electrical data

Supply circuits ..... (Connections at X1 1/2[+] resp. 3/4[+]; 7/8[-])	U = 24 V d. c. (max. 30 V d. c.) U_m = 250 V
Signal circuits ..... (Connections at X1 15/16 and 9/10 resp. 13/14 and 11/12	U = 24 V d. c. (max. 30 V d. c.); 4 ... 20 mA U_m = 250 V
Supply circuits ..... (Connections at X2 13/14 and 15/16 resp. 19/20 and 21/22	in type of protection Intrinsic Safety Ex ia IIB resp. Ex iaD Maximum values per circuit: U_o = 23 V I_o = 64.5 mA P_o = 799 mW Characteristic line: trapezoidal Effective internal capacitance: 22 nF Effective internal inductance: 76.5 µH

Ex ia	IIB		
max. permissible external inductance	4.8 mH	0.9 mH	0.12 mH
max. permissible external capacitance	358 nF	418 nF	718 nF

The maximum values of the tables are also allowed to be used up to the permissible limits as concentrated capacitances and as concentrated inductances.
The intrinsically safe circuits are safely galvanically separated from the non intrinsically safe circuits up to the peak crest value of the voltage of 375 V.
The intrinsically safe circuits are safely galvanically separated from each other.

(16) The test documents are listed in the test report No. 09 203 554881.

(17) Special conditions for safe use

none

(18) Essential Health and Safety Requirements

no additional ones

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Translation

1. S U P P L E M E N T

to Certificate No.	**TÜV 09 ATEX 554881**
Equipment:	Transmitter power supply type IMB-AIA-22Ex-Hi/24VDC
Manufacturer:	Hans Turck GmbH & Co. KG
Address:	Witzlebenstraße 7 45472 Mülheim an der Ruhr, Germany
Order number:	8000555876
Date of issue:	2010-07-29

In the future, also L_o- and C_o values for gas group IIC are listed for the transmitter power supply type IMB-AIA-22Ex-Hi/24VDC.

The new marking reads as follows:
II (1) G [Ex ia Ga] IIC/IIB and II (1) D [Ex ia Da] IIIC

The electrical data are changed as follows:

Electrical data

Supply circuits ..... (Connections at X2 13/14 and 15/16 resp. 19/20 and 21/22	in type of protection Intrinsic Safety Ex ia IIB/IIC resp. Ex ia IIIC Maximum values per circuit: U_o = 23 V I_o = 64.5 mA P_o = 799 mW Characteristic line: trapezoidal Effective internal capacitance: 22 nF Effective internal inductance: 76.5 µH

Ex ia	IIB			IIC		
max. permissible external inductance	4.8 mH	0.9 mH	0.12 mH	0.804 mH	0.424 mH	0.024 mH
max. permissible external capacitance	358 nF	418 nF	718 nF	46 nF	62 nF	121 nF

The values for IIB and for IIC are also permissible for explosive dust atmospheres.

The maximum values of the tables are also allowed to be used up to the permissible limits as concentrated capacitances and as concentrated inductances.

The intrinsically safe circuits are safely galvanically separated from the non intrinsically safe circuits up to the peak crest value of the voltage of 375 V.
The intrinsically safe circuits are safely galvanically separated from each other.

All other data remain unchanged for this supplement.

The equipment according to this supplement meets the requirements of these standards:

EN 60 079-0:2009 EN 60 079-11:2007 EN 61241-11: 2006

(16) The test documents are listed in the test report No. 10 203 556066.

(17) Special conditions for safe use

none

(18) Essential Health and Safety Requirements

no additional ones

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The head of the certification body

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Translation

(1) EC-Type Examination Certificate

(2) Equipment and protective systems intended for use in potentially explosive atmospheres, **Directive 94/9/EC**

(3)	**Certificate Number**	**TÜV 09 ATEX 555410**
(4)	for the equipment:	Solenoid Driver type IMB-DO-**Ex/24VDC
(5)	of the manufacturer:	Hans Turck GmbH & Co. KG
(6)	Address:	Witzlebensstraße 7 45472 Mülheim (Ruhr) Germany
	Order number:	8000555410
	Date of issue:	2009-11-30

(7) This equipment or protective system and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) The TÜV NORD CERT GmbH, notified body No. 0044 in accordance with Article 9 of the Council Directive of the EC of March 23, 1994 (94/9/EC), certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive. The examination and test results are recorded in the confidential report No. 09 203 554858.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 60079-0:2006 EN 60079-11:2007 EN 61 241-0:2006 EN 61 241-11:2006

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-type examination certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(12) The marking of the equipment or protective system must include the following:

II (1) G [Ex ia] IIB resp. II (1) D [Ex iaD]

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(13) **S C H E D U L E**

(14) **EC-Type Examination Certificate No. TÜV 09 ATEX 555410**

(15) Description of equipment

The Solenoid Driver type IMB-DO-**Ex/24VDC is used for the supply of intrinsic safe passive two-poles (e. g. solenoid valves, illuminated circuit diagrams, light emitting diodes, two wire transmitters) as well as for the safe galvanic separation of the intrinsically safe circuits and the non intrinsically safe circuits.

The intrinsically safe circuits may also be connected to devices for the use in dust explosive areas if the devices are certified accordingly.

The device is executed with 4 channels.

The permissible ambient temperature range is -25°C ... 70°C.

Electrical Data

Supply circuit ..... (X1-contact 1/2[+] resp. 3/4[+], 7/8[-])	U = 24 V d.c. (max. 30 V d.c.), ca. 3W U_m= 250 V a.c. resp. 125 V d.c.
Control circuits (X1-contact 9/10 [+] resp. 11/12 [+],..... resp. 13/14 [+], resp. 15/16 [+], 7/8 [-])	U = 24 V d.c. (max. 30 V d.c.) U_m= 250 V a.c. resp. d.c.
Output circuits.. (X2-contact 1/2[+], 3/4[-]), resp. 7(8[+], 9/10[-]), resp. 13/14[+], 15/16[-]), resp. 19/20[+], 21/22[-]),	in type of protection Intrinsic Safety Ex ia IIB resp. Ex iaD Maximum values per channel: U_o = 21.1 V I_o = 75.3 mA P_o = 0.898 W R_i = 95.39 Ω Characteristic line: angular The effective internal capacitances and inductances are negligibly small.

Ex ia	IIB
max. permissible external inductance	12 mH
max. permissible external capacitance	0.62 µF

The maximum values of the table are also allowed to be used up to the permissible limits as concentrated capacitances and as concentrated inductances.

The intrinsically safe circuits are galvanically connected with each other.
The intrinsically safe circuits are safely galvanically separated from all non intrinsically safe circuits up to the peak crest value of the voltage of 375 V.

(16) Test documents are listed in the test report No. 09 203 555410.

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(17) Special conditions for safe use

none

(18) Essential Health and Safety Requirements

no additional ones

Translation

1. SUPPLEMENT

to Certificate No.	**TÜV 09 ATEX 555410**
Equipment:	Solenoid driver type IMB-DO-**Ex/24VDC
Manufacturer:	Hans Turck GmbH & Co. KG
Address:	Witzlebenstraße 7 45472 Mülheim an der Ruhr, Germany
Order number:	8000556183
Date of issue:	2010-11-04

In the future, the marking of the solenoid driver type IMB-DO-**Ex/24VDC reads as follows:
II (1) G [Ex ia Ga] IIB and II (1) D [Ex ia Da] IIIC

Electrical data

Output circuits.. (X2-contact 1/2[+], 3/4[-] resp. 7/8[+], 9/10[-] resp. 13/14[+], 15/16[-] resp. 19/20[+], 21/22[-])	in type of protection Intrinsic Safety Ex ia IIB resp. Ex ia IIIC Maximum values per channel: U_o = 21.1 V I_o = 75.3 mA P_o = 0.898 W R_i = 95.39 Ω Characteristic line: angular The effective internal capacitances and inductances are negligibly small.

Ex ia	IIB
max. permissible external inductance	12 mH
max. permissible external capacitance	0.62 µF

The values for IIB are also permissible for explosive dust atmospheres.

The maximum values of the table are also allowed to be used up to the permissible limits as concentrated capacitances and as concentrated inductances.

The intrinsically safe circuits are galvanically connected with each other.
The intrinsically safe circuits are safely galvanically separated from the non intrinsically safe circuits up to the peak value of the voltage of 375 V.

All other details remain unchanged.

The equipment according to this supplement meets the requirements of these standards:

EN 60079-0:2009 EN 60079-11:2007 EN 61241-11: 2006

(16) The test documents are listed in the test report No. 10 203 556183.

(17) Special conditions for safe use

none

(18) Essential Health and Safety Requirements

no additional ones

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The head of the certification body

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Translation

(1) EC-Type Examination Certificate

(2) Equipment and protective systems intended for use in potentially explosive atmospheres, **Directive 94/9/EC**

(3)	**Certificate Number**	**TÜV 09 ATEX 555612**
(4)	for the equipment:	Isolating amplifier type IMB-AO-22Ex-Hi/24VDC
(5)	of the manufacturer:	Hans Turck GmbH & Co. KG
(6)	Address:	Witzlebensstraße 7 45472 Mülheim (Ruhr) Germany
	Order number:	8000555612
	Date of issue:	2009-12-17

(7) This equipment or protective system and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) The TÜV NORD CERT GmbH, notified body No. 0044 in accordance with Article 9 of the Council Directive of the EC of March 23, 1994 (94/9/EC), certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive. The examination and test results are recorded in the confidential report No. 09 203 555612.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 60079-0:2006 EN 60079-11:2007 EN 61 241-0:2006 EN 61 241-11:2006

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-type examination certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(12) The marking of the equipment or protective system must include the following:

II (1) G [Ex ia] IIB resp. II (1) D [Ex iaD]

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(13) **S C H E D U L E**

(14) EC-Type Examination Certificate No. TÜV 09 ATEX 555612

(15) Description of equipment

The Isolating amplifier type IMB-AO-22Ex-Hi/24VDC is used for the galvanically separated supply of apparatus in explosion hazardous areas as well as for the safe galvanic separation of non intrinsically safe measuring signals and intrinsically safe output signals.

The intrinsically safe circuits may also be connected to devices for the use in dust explosive areas if the devices are certified accordingly.

The device is executed with 2 channels.

The permissible ambient temperature range is -25°C ... 70°C.

Electrical Data

Supply circuit ..... U = 24 V d.c. (max. 30 V d.c.), ca. 2 W
(X1-contacts 1/2[+] resp. 3/4[+], 7/8[-]) U_m = 250 V a.c. resp. 125 V d.c.

Signal circuits ..... U = 24 V d.c. (max. 30 V d.c.), 4...20mA
(X1-contacts 9/10 and 13/14 U_m = 250 V a.c. resp. d.c.
resp. 11/12 and 15/16)

Output circuits ..... in type of protection Intrinsic Safety Ex ia IIB resp. Ex iaD
(X2-contacts 13/14 and 15/16 Maximum values per channel:
resp. 19/20 and 21/22) U_o = 25 V
I_o = 49 mA
P_o = 760 mW
R_i = 193 Ω
Characteristic line: angular
The effective internal capacitances and inductances are negligibly small.

Ex ia	IIB	
max. permissible external inductance	21 mH	0,2 mH
max. permissible external capacitance	0.36 µF	0.67 µF

The maximum values of the table are also allowed to be used up to the permissible limits as concentrated capacitances and as concentrated inductances.

The intrinsically safe circuits are safely galvanically separated from all non intrinsically safe circuits up to the peak value of the voltage of 375 V.

(16) Test documents are listed in the test report No. 09 203 555612.

(17) Special conditions for safe use

none

18) Essential Health and Safety Requirements

no additional ones

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Translation

1. S U P P L E M E N T

to Certificate No.	**TÜV 09 ATEX 555612**
Equipment:	Isolating amplifier type IMB-AO-22Ex-Hi/24VDC
Manufacturer:	Hans Turck GmbH & Co. KG
Address:	Witzlebenstraße 7 45472 Mülheim an der Ruhr, Germany
Order number:	8000556144
Date of issue:	2010-09-27

In the future, the isolating amplifier type IMB-AO-22Ex-Hi/24VDC may also be manufactured according to the documents listed in the test report.

The changes refer to the voltage and current limiting circuitry for the output circuits as well as to the L_o- and C_o values for gas group IIC and the marking.

The marking reads as follows:
II (1) G [Ex ia Ga] IIC and II (1) D [Ex ia Da] IIIC

The electrical data are changed as follows:

Electrical data

Supply circuits ..... (X2-Kontakte 13/14 and 15/16 resp. 19/20 and 21/22	in type of protection Intrinsic Safety Ex ia IIB/IIC resp. Ex ia IIIC Maximum values per channel: U_o = 25 V I_o = 49 mA P_o = 760 mW R_i = 193 Ω Characteristic line: angular The effective internal capacitances and inductances are negligibly small.

Ex ia	IIC		IIB	
max. permissible external inductance	0.5 mH	0.2 mH	21 mH	0,2 mH
max. permissible external capacitance	0.087 µF	0.11 µF	0.36 µF	0.67 µF

The values for IIB and for IIC are also permissible for explosive dust atmospheres.

The maximum values of the tables are also allowed to be used up to the permissible limits as concentrated capacitances and as concentrated inductances.

The intrinsically safe circuits are safely galvanically separated from the non intrinsically safe circuits up to the peak value of the voltage of 375 V.

All other details remain unchanged.

The equipment according to this supplement meets the requirements of these standards:

EN 60 079-0:2009 EN 60 079-11:2007 EN 61241-11: 2006

(16) The test documents are listed in the test report No. 10 203 556144.

(17) Special conditions for safe use

none

(18) Essential Health and Safety Requirements

no additional ones

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The head of the certification body

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Translation

(1) EC-Type Examination Certificate

(2) Equipment and protective systems intended for use in potentially explosive atmospheres, **Directive 94/9/EC**

(3)	**Certificate Number**	**TÜV 10 ATEX 556047**
(4)	for the equipment:	Temperature transmitter type IMB-TI-***-231Ex-HCi/24VDC
(5)	of the manufacturer:	Hans Turck GmbH & Co. KG
(6)	Address:	Witzlebenstraße 7 45472 Mülheim (Ruhr) Germany
	Order number:	8000556047
	Date of issue:	2010-07-26

(7) This equipment or protective system and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) The TÜV NORD CERT GmbH, notified body No. 0044 in accordance with Article 9 of the Council Directive of the EC of March 23, 1994 (94/9/EC), certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive. The examination and test results are recorded in the confidential report No. 10 203 556047.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 60079-0:2009 EN 60079-11:2007 EN 61 241-11:2006

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-type examination certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(12) The marking of the equipment or protective system must include the following:

II (1) G [Ex ia Ga] IIC/IIB resp. II (1) D [Ex ia Da] IIIC

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(13) **S C H E D U L E**

(14) **EC-Type Examination Certificate No. TÜV 10 ATEX 556047**

(15) Description of equipment

The temperature transmitter type IMB-TI-***-231Ex-HCi/24VDC is used for the safe galvanic separation between the intrinsically safe measuring circuits and the non intrinsically safe circuits. It is also used for the measurement of temperatures by thermocouples or RTD-sensors in the explosion hazardous area and for signal transmission.
The intrinsically safe measuring circuits may also be connected to apparatus in explosion hazardous areas caused by dust, which are certified accordingly.

The apparatus is executed with 2 channels.

The permissible ambient temperature range is -25°C … 70°C.

Electrical data

Supply circuit …… (Connections X1; 1/2[+] resp. 3/4[+]; 7/8[-])	U = 24 V d. c. (max. 30 V d. c.) ; ca. 2 W U_m = 250 V
Output circuits (measuring signals) …… (Connections X1; 13/14 and 9/10; 15/16 and 11/12)	U = 20 V d. c.; 0/4 … 20 mA U_m = 250 V
Output circuit (fault signal) …… (Connections X1; 17/18 and 19/20)	U = 20 V d. c.; 3 mA; floating U_m = 250 V
Configuration interface RS 232C …… (Front-side programming jack)	U = 5V U_m = 250 V
Measuring circuits …… (Connections X2; channel 1: 13/14[+], 15/16[-],19/20[+], 21/22[-] channel 2: 7/8[+], 9/10[-], 1/2[+], 3/4[-])	in type of protection Intrinsic Safety Ex ia IIB/IIC resp. Ex ia IIIC Maximum values per channel: U_o = 5 V I_o = 5 mA P_o = 6.2 mW Characteristic line: linear Effective internal inductance: 73 µH The effective internal capacitance is negligibly small.

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Ex ia	IIB			IIC		
max. permissible external inductance	100 mH	10 mH	1 mH	100 mH	10 mH	1 mH
max. permissible external capacitance	10 µF	13 µF	21 µF	1.8 µF	2.4 µF	3.4 µF

The values for IIB and for IIC are also permissible for explosive dust atmospheres.

The maximum values of the tables are also allowed to be used up to the permissible limits as concentrated capacitances and as concentrated inductances.

The intrinsically safe circuits are safely galvanically separated from the non intrinsically safe circuits up to the peak value of the voltage of 375 V.

(16) Test documents are listed in the test report No. 10 203 556047.

(17) Special conditions for safe use

none

18) Essential Health and Safety Requirements

no additional ones

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